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Marine Engineers' Prize Contest

As announced in our last issue, cash prizes of $15, $10 and $5 are offered by this journal for the three best letters sent by marine engineers to our Contest Editor before January 1, 1915, telling about their experiences in the engine room. As only a month remains before this contest closes, readers should forward their letters without delay. Any subject relating to the construction, installation or operation of marine machinery may be chosen, including breakdowns and repairs, and any engineer may send as many letters as he chooses. Each letter that is awarded a prize will be paid for at the time of publication at regular space rates, in addition to the prize. Also any other letters that fail to receive a prize, but which are considered worthy of publication, will be published in later issues of the magazine and paid for at regular space rates.

Notable Addition to the American Coastwise Fleet

Within a few months the Spokane, Portland and Seattle Railway Company will place in service between Astoria, Ore., and San Francisco, Cal., two splendidly equipped 23-knot, triple-screw, turbine-driven passenger and freight ships that are now nearing completion at the yards of the William Cramp & Sons Ship and Engine Building Company, in Philadelphia. This steamship line will complete a direct route from the East to San Francisco over the Great Northern Railway lines, and as the passage by boat from Astoria to San Francisco will be made in from 25 to 26 hours, the schedule along the coast by water will be equivalent to the overland journey by rail. As can be seen from the description of these vessels, published elsewhere in this issue, the new steamships will be of the finest type that the modern art of shipbuilding can produce. Every convenience and luxury known to ocean travelers compatible with the paramount requisite of safety and reliability in navigation has been incorporated in their design. Propulsion is by a three-shaft arrangement of Parsons turbines supplied with steam by oil-fired watertube boilers. Extensive use of electricity, both for lighting and for power purposes, has been made, and the important problems of heating and ventilation and the rapid handling of freight have been worked out with exceptional care. The creation of this noteworthy addition to the American coastwise fleet reflects great credit on the owners and builders of the vessels, not only from an engineering standpoint, but also as a step in advance in the complex problem of transportation. The trials and service runs of the *Great Northern* and *Northern Pacific* will be watched with interest.

Isherwood Framed Tank Ships

Extensive as the application of the Isherwood system of longitudinal framing has been to various types of vessels—two hundred and twenty-six such vessels, aggregating 1,182,200 gross tons, were classed by Lloyds up to June 30, 1914—this form of construction has found special favor, both from the designer's and from the owner's point of view, in oil tank ships. The principal advantage from the designer's standpoint is the fact that the required strength of the ship can be obtained with a great saving in weight over the ordinary system of transverse framing, while from the owner's point of view the saving in weight means added earning capacity for the ship. It is pointed out, however, in an article on Tank Ship Construction, printed on another page of this issue, that the opinion seems to be prevalent among shipowners that the Isherwood framed ship requires more frequent repairs and is shorter lived. If this condition is real and is not the outgrowth of prejudice among shipowners, it by no means presents an obstacle that cannot be overcome as further experience is gained. What is of more importance, however, is the difficulty encountered by shipbuilders in the actual work of constructing the hull. Every part of the ship must be completed at a definite time and worked into the structure at a certain period of construction, otherwise the entire work will be delayed and the cost of construction will rapidly mount up. It is in points like this that experience counts, and readers who are unfamiliar with the actual procedure in the erection of an Isherwood framed ship will do well to study carefully the article dealing with this subject.

Bids for New Destroyers

When the bids for the six new destroyers authorized by the last Congress were opened on November 10 at the Navy Department it was found that an estimate submitted by the Mare Island Navy Yard, California, was about $200,000 (£41,000) less for each destroyer than the bids submitted by private shipbuilding firms. If this estimate could be considered as a strictly competitive bid, it would, of course,

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be most attractive, but past experience with naval construction in Government navy yards has given ample proof that it is practically impossible for a navy yard to build a warship as cheaply as a private shipyard can build it, and, furthermore, the cost of repairs on Government-built vessels invariably amounts to a larger sum than the cost of repairs to a contract-built ship. It should not be forgotten that a number of private shipbuilding firms, such as Wolff & Zwicker, of Portland, Oregon; the Charles Hillman, Trigg and other companies failed and went out of business years ago in their efforts to build far less complicated destroyers than the vessels authorized to-day at approximately the same price per ton as the Mare Island Navy Yard offers to build the new destroyers, while several other private concerns were seriously crippled financially in their attempts to meet Government prices. It is physically impossible for a Government yard which must depend upon employees inexperienced in construction work to turn out a naval vessel of the type of the new destroyers at about $200,000 (£41,000) less than it is possible for a private shipyard with its years of experience and its skilled organization, trained in this particular kind of work, to do the same work. Moreover, when a Government yard fails to complete the construction of a vessel within the appropriation made for it, it is possible to get additional appropriations from Congress to cover the extra expense; while if such a loss occurs in a private contract, the contractor must suffer the loss.

Lloyd's Annual Report

For the year ended June 30, 1914, 713 new vessels of 2,020,185 gross tons were classed by Lloyd's Register of Shipping, and these figures represent the highest total for any one year recorded in the history of the society. Of the total, about 60 percent were built for the British Empire and about 40 percent for other countries. The total number of merchant vessels classed by Lloyd's up to June 30 was 10,621, registering nearly 24,000,000 gross tons. In commenting on the year's activity in shipbuilding, the Annual Report of Lloyd's Register, just issued, calls attention to many features which are of special interest to the shipbuilder.

Chief among these features is the rapidly increasing use of steam turbines, and especially the application of geared turbines. At present there are 23 vessels being built to Lloyd's classification in which geared turbines are to be fitted. The introduction of geared turbines has enabled a high peripheral speed to be obtained by using comparatively small rotor drums running at very high rates of revolution geared with the screw shaft running at the lower rate of revolutions which would be used with reciprocating engines of the same power, thus combining the high efficiencies of steam turbines and of slow-running propellers. At the same time, six merchant vessels are now under construction to Lloyd's Classification in which direct turbine drive will be used, and also six vessels in which the three-shaft arrangement of combination machinery will be installed. An advantage of the three-shaft combination machinery, in which the outer shafts are driven by reciprocating engines and the center shaft by a low-pressure turbine, is that the machinery can be worked at reduced power with practically the same efficiency as at full power. The speed of these engines is reduced by "linking up," enabling the full steam pressure to be utilized in the cylinders, whereas with ordinary steam turbines the speed can be regulated only by varying the steam pressure so that when less than full power is required the steam pressure has to be reduced and a corresponding loss of efficiency results.

Another feature to which attention is directed in the report is the increasing number of large Diesel-engined motor ships, there being at the present time 27 vessels holding Lloyd's Classification which are fitted with Diesel engines, aggregating approximately 50,000 indicated horsepower, and 20 others of the same type now building. One of the principal Diesel motor ship owners is the East Asiatic Company, whose earliest vessel of this type, the *Selandia*, has two 8-cylinder engines with cylinders 20⅞ inches diameter by 28¼ inches stroke, aggregating 2,500 indicated horsepower. The latest vessel owned by this company is the *Fionia*, in which two 6-cylinder engines with cylinders 29⅛ inches diameter by 43 5/16 inches stroke, aggregating 4,000 horsepower, are installed. These are the largest cylinders which, as yet, have been used for Diesel engines in merchant ships.

During the last year 19 vessels, each of over 10,000 gross tons, have been classed by Lloyd's, the largest being the Cunard liner *Aquitania*, of 45,649 gross tons. At the present time no less than 15 steamships of 12,000 tons and over are under construction under Lloyd's Classification, while the special types of vessels classed by Lloyd's during the year included 72 oil tankers of 402,033 tons, 5 of which were over 10,000 gross tons each, and 72 vessels of 429,384 tons, built on the Isherwood system of longitudinal framing. This brings the number of vessels of this type built under Lloyd's Survey up to 226, totaling 1,182,200 tons gross.

While Lloyd's rules provide for the construction of vessels conforming to a standard of strength entitling them to the highest class, the technical committee of the society is always prepared to approve of proposals involving variations from the methods of construction specified in the rules, provided equivalent structural strength is maintained. The committee is also prepared to assign classes to vessels intended for special purposes so long as the scantlings and arrangements proposed render the vessels efficient for the employment contemplated. Special types of vessels assigned classes in this way during the last year included the steamers *Atlantic* and *Pacific*, built by the Fore River Shipbuilding Corporation, Quincy, Mass., which are the largest lumber steamers flying the American flag; two vessels for the Russian Government and one for Australia intended to carry oil in bulk and especially strengthened for the purpose of supplying warships with fuel oil at sea; and an auxiliary schooner yacht being

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built by Lawley & Sons, Boston, Mass., in the construction of which alloy steels of high tensile strength are used in order to reduce the scantlings and at the same time meet Lloyd's requirements for structural strength.

Important changes in Lloyd's staff during the past year, some of which have already been noted in these columns, included the appointment of Prof. W. S. Abell, professor of naval architecture at the University of Liverpool, to the office of chief ship surveyor, filling the vacancy caused by the death of Dr. S. J. P. Thearle; the promotion of Mr. Charles Buchanan, formerly assistant to the chief ship surveyor, to the position of principal of the chief ship surveyor's staff, which he was forced to resign in September on account of ill health; and the appointment of Mr. James French, formerly on special duty in the United States, to the post of principal surveyor at Glasgow, succeeding Mr. T. J. Dodd, retired. A number of additional surveyors were also appointed in foreign ports, so that there are now 89 Lloyd's surveyors stationed in various ports outside Great Britain.

American Society of Naval Architects

Organized in 1893 to promote practical and scientific knowledge in the arts of shipbuilding and marine engineering, the Society of Naval Architects and Marine Engineers has held regularly at least once each year, and sometimes oftener, meetings for social intercourse and for the reading and discussion of professional papers. The information thus brought out has been made available to the members by the publication of the transactions of the Society. The membership is divided into classes designated as members, associates, juniors, honorary members and honorary associates. The number of honorary members and honorary associates is limited, and the honor of holding this membership is conferred by the Council. Eligibility for membership in the other grades depends upon the experience of the applicant in the practice of the profession of naval architecture and marine engineering or his association with allied industries. The entrance fees and annual dues are nominal and insignificant in comparison with the value of the transactions of the society, which are circulated among all the members. It is desirable for every naval architect and marine engineer to become a member of this society, on account of the opportunity offered to become more intimately acquainted with the leaders in the profession and also to learn much valuable knowledge from the extensive experience of others in the same branch of engineering. Considering the fact that a member of any grade has full access to the complete proceedings of the society, naval architects and marine engineers in foreign countries will find it a distinct advantage to become enrolled in the society, and it is to be hoped that as the society continues to grow its membership will include a greater number of men allied with the shipbuilding industry in every part of the world.

Some indications of the recent tremendous strides in the art of shipbuilding are shown by comparison with the views brought out at the first meeting of the society over twenty years ago regarding the evolution of the Atlantic "greyhound." In a paper on this subject by Mr. Charles H. Cramp it was stated that the limit of commercial practicability in the size and speed of the transatlantic steamship had been reached in the Cunard liner *Campania*. At that time the limit of draft in the principal harbors was about 28 feet, and, while it was hoped that before long, by dredging away bars and deepening docks, it might become practical to design a ship on dimensions permissible with a draft of 30 feet, which would mean a ship about 700 feet long and 75 to 80 feet beam, it was not considered worth while, however, to consider such a contingency! In the interval between that first meeting and the present time tremendous strides in the evolution of the modern transatlantic liner have taken place, and various phases of the problems encountered in this remarkable evolution are discussed in the successive volumes of the Society's transactions, forming a library of inestimable value with which every naval architect and marine engineer should be familiar.

Electric Propulsion

It is seldom that a new system of ship propulsion has vindicated the claims of its designers more completely at the start than was the case with the electric drive installed on the United States collier *Jupiter*. This ship has been in commission for over a year and a half; she has steamed about 14,000 miles, and has been placed through every conceivable maneuver under all conditions of service. The economy which she has shown is from 20 to 25 percent better than her sister ships, and, so far, no troubles of a serious nature have developed and the performance has been satisfactory in every respect. As a result the Navy Department has decided to install electric drive on the battleship *California*, to be built at the New York Navy Yard. The *Jupiter* was designed for a speed of 14 knots, and, on a draft of 27 feet 9 inches, displaces 19,452 tons. The propelling machinery consists of a 9-stage Curtis turbine connected to a 2-pole 3-phase AC generator and two 36-pole 3-phase induction motors. The turbine operates at 1,990 revolutions per minute and the motors at 110 revolutions per minute. On her 48-hour full-speed trial, the vessel attained a speed of 14.99 knots, the propellers turning at 116.72 revolutions per minute and the motors developing a shaft horsepower of 7,151.9. The water rate per shaft horsepower was 11.68 pounds, which is 10.15 percent better than the guarantee of 13 pounds. On her 24-hour trial at 10 knots, the water rate per shaft horsepower was 12.316 pounds, or 18 percent better than the guarantee of 15 pounds. The coal consumption per shaft horsepower at full speed was 1.662 pounds and at 10 knots speed 2.51 pounds. Some of the special advantages pointed out by the officers in charge of the *Jupiter* are the fact that the vessel can make her contract speed without using forced draft, that the machinery is very handy for maneuvering, and that there is a total absence of racing at sea on account of the action of the governor.

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Tank Ship Construction

Features of Construction as Applied Especially to Isherwood Framed Oil Tankers

BY ROBERT WHITING MORRELL, M. E.

The tank ship for carrying oil in bulk is undoubtedly the most highly specialized type of merchant vessel. It embodies a combination of features entirely unique and distinctive. Much has already been written on the subject of tank-ship design from the naval architect's standpoint. We can, therefore, pass over the questions of dimensions, coefficients, form, speed, strength and scantlings, to a consideration of the special features of construction which are peculiarly adapted to this type of vessel from the standpoint of the yard superintendent, the surveyor, and the owner.

It may be of interest to note in passing that when the length between perpendiculars exceeds twelve and one-half times the depth, recent experience has indicated the advisability of a slight increase in longitudinal strength beyond that required by the scantling rules. In this connection there is a splendid opportunity for obtaining useful data by means of a micrometer attachment on the ship's deck. Observations made on a large tank ship in March, 1914, in the light and loaded conditions showed about 4 inches sag when loaded.

The question of whether the ship should be of the shelter-deck type or of the forecastle, bridge and poop-deck type is an important one. The shelter-deck type has the advantage of providing greater freeboard and greater strength, thus increasing the cargo-carrying capacity. It also permits the steam and exhaust piping to deck machinery and pumps, the smothering pipes, heater pipes, etc., to be carried below deck, where they are better protected. It makes a drier ship, and provides unexposed means of access all fore-and-aft, and affords better support for the masts. Furthermore, part of the 'tween deck space can often be used to carry fuel.

On the other hand, the shelter-deck type is more expensive construction and increases the registered tonnage and certain fees. The selection of the type can, therefore, only be determined by the particular needs of the vessel in question.

In considering the question of framing, namely, the Isherwood, or longitudinal system vs. the ordinary transverse system, there are several points involved.

From the designer's standpoint the Isherwood system is pre-eminently suited to the tank ship. The designer must deal not only with the strength of the ship as a whole, but with excessive local stresses due to the pressure of oil. With the Isherwood system the framing, the deck beams and the stiffeners on the longitudinal bulkheads run fore-and-aft instead of vertically or transversely; and thus the members designed to withstand the local stresses also incorporate themselves into the longitudinal strength of the ship as a whole. In this way the designer is enabled to obtain the required strength with a great saving in weight over that required by the old transverse system.

From the standpoint of the yard superintendent the Isherwood system is a great bugbear. In the mold loft the unequal spacing of the transverse or belt frames throughout the ship makes shell and frame development and the use of universal molds exceedingly complicated. The longitudinal frames, usually long lengths of heavy bulb or channel section, are very unwieldy and difficult to handle and work in the shops. The work in the ship is particularly difficult to fair up and pull into place. The worst feature, however, is the order of assembling work in the ship. Each particular member must be put in its place at a certain definite period in construction, else it cannot be gotten in. If one piece of material is overlooked, the ship has to be torn apart to get it in; or if any particular parts are not ready when the ship is ready for them, the entire work comes to a standstill until they are obtained. These disadvantages of the Isherwood system make it very costly and unpopular from the yard's standpoint.

From the owner's point of view the Isherwood system, in effecting a saving in weight of structural material, affords an increase in the earning capacity of the ship. To offset this, however, are recent reports from those operating tank ships of the Isherwood type, that there is a marked deflection and lack of rigidity in the ship as a whole; in other words, the ship "works." This, however, might result as readily in a ship of the same dimensions with transverse framing of equivalent strength. One point against the Isherwood system is that, in case it becomes necessary to renew any structural members, the repair bill is very large, on account of the difficulty in getting the various parts out or in. The opinion also seems prevalent among shipowners that the Isherwood ships require more frequent repairs and are shorter lived; they claim that, due to the large area between transverses, supported only by light longitudinals, the ship becomes dented very easily in docking or otherwise.

It has become almost a fixed rule to locate the propelling machinery at the extreme stern in a tank ship. The reasons for this are: First, that with the machinery amidships it would cause an abrupt discontinuity in the structural design, greatly affecting the strength; also, when loaded, the weight is in the ends, putting a severe hogging strain on the ship; second, it would require a cofferdam bulkhead forward and aft of the machinery and bunker space, to isolate it from the oil space, involving additional weight and cost; third, it would require an oil-tight shaft alley through the after oil space, which would be a heavy and expensive proposition.

Practice varies regarding the location of the pump room. Usually it is located amidships, between two oil tanks, which makes a good, central location. One disadvantage of this is that, if there is any leak in the oil-tight bulkheads, the pump space becomes dangerous, and cofferdam bulkheads are not warranted. The pump room, located amidships, also causes a break in the continuity of the strength members, due to openings in the centerline bulkhead and the deck in this space. It is necessary to compensate for the decrease in strength. The opening in the deck should have round corners, as square corners afford a point of weakness at which the deck plating will crack. Some are in favor of placing the oil pumps back in the machinery space, to do away with the long lead of steam piping. The objection to this is that it extends the machinery space forward, which is undesirable, as the ship will trim by the head when loaded with bunkers empty, unless the oil space is kept as far aft as possible. Another solution is to place the pump room directly forward of the oil space. The only objection to this is the long length of pipe lines, which is not so important when it is considered that in many places steam from the shore is used on the pumps.

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When running light it is necessary to carry water ballast forward to balance the weight of the machinery aft. For this purpose the forepeak tank is fitted for water ballast, and a deep tank is provided in the space forward of the oil space. In addition to this water is generally carried in some of the main oil tanks to bring the ship down to a suitable draft, and to prevent hogging. The afterpeak tank is also fitted for water ballast, which is necessary to carry aft if the ship has a tendency to trim by the head when loaded. Double bottoms are usually fitted under the machinery space, in which water ballast, reserve feed, or fuel oil may be carried.

If coal is burned, side bunkers should be used in the boiler space if possible. If this is impossible or insufficient, a cross bunker, kept as far aft as possible, is provided. If the ship is of the shelter-deck type the coal may be carried in the 'tween decks, with chutes to the fire room. It is possible to extend the poop deck forward to provide a similar bunker.

With fuel oil the double bottoms under the machinery space are used as bunkers, and the forward deep tank may also be used. If necessary, a fuel oil tank just forward of the boiler room can be provided. In this case an asbestos insulation is necessary on the forward fireroom bulkhead. Filling pipes for this tank can be connected to the cargo oil system.

The cargo oil space extends as far forward and aft as the trim of the ship will permit, and terminates in cofferdams which isolate it from the rest of the ship. The oil space is divided by transverse oiltight bulkheads into a number of tanks not over 28 feet in length. An oiltight centerline bulkhead divides the ship into port and starboard tanks. In order to reduce the free surface of the oil, for the purpose of stability, an expansion trunk is provided, comprising not over half the width of the tank.

An oiltight main deck extends throughout the oil space, from the shell to the expansion trunk bulkhead. The latter is an oiltight longitudinal bulkhead extending from the main deck to the upper deck, port and starboard. The space between the centerline and this bulkhead is the expansion trunk.

The upper deck is next above the main deck and extends from shell to shell, and is oiltight thoughout. This deck forms the top of the oil space. The small wing tanks formed by the shell, the main deck, the expansion trunk bulkhead and the upper deck are known as the summer tanks, presumably for the reason that only in summer, when the oil is light, these tanks can be filled; which, however, does not always hold true.

The Isherwood framing in the oil space consists of heavy transverse or belt frames, spaced about 9 or 10 feet apart, and a series of longitudinal frames, usually of channel section on the bottom and bilge, and of bulb angles on the side shell. These are intercostal between transverse bulkheads, to which they are bracketed, and they pass through slots in the transverse frames.

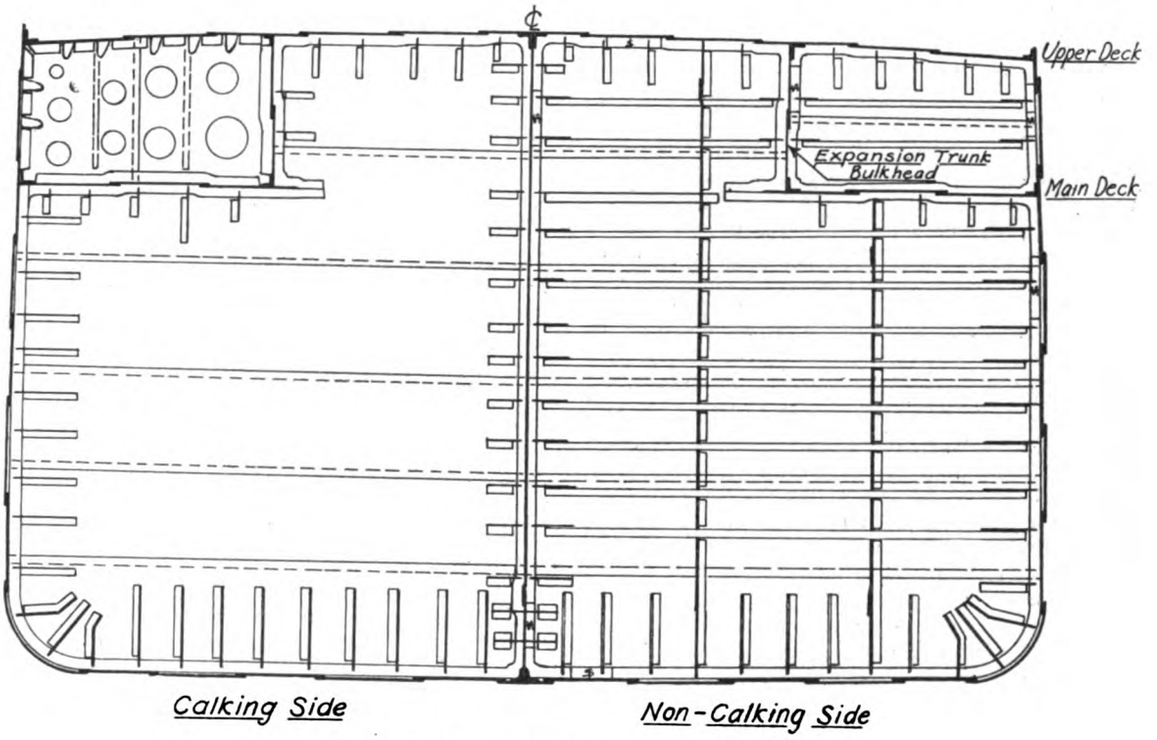

Fig. 1.—Construction of Bulkhead for an Oil Tanker

This brings us to a consideration of the various structural features which will be taken up in the order in which they are assembled in the ship.

In the mold lofts molds can be made for almost every piece of material in the oil space, and in this way the material can be gotten out in advance and is ready for assembling whenever wanted. The only exceptions are: certain outside strakes of shell plating forward and aft and one strake amidships; all of the brackets connecting the centerline bulkhead to the transverse bulkheads; certain strakes of deck plating; deck stringer angles forward and aft, and the bounding angles on the oiltight summer tank bulkheads. All these members should be lifted from the ship. The shell longitudinals have to be developed in a manner similar to the shell plating. It is important to check all molds, to make sure that the required rivet spacing and number of rivets are provided before the steel is punched.

The flat keel is oiltight throughout the oil space. The rivet spacing and calculations can be found in any book of rules, and will not be dealt with here. If inside keel buttstraps are fitted they should be cut about 1 inch clear of

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the toe of the keel angles on each side. This enables the angles to continue through without linering, and the strap being cut slack provides a runway for the oil to the bleeders and gives room for calking the toe of the keel angles. The vertical keel, which forms the bottom strake of the centerline bulkhead, is shipped immediately after the flat keel. The vertical keel plating, being a strength member, must rest solidly on the flat keel. The plates should be butt-lapped, with scarfs in way of the keel angles. Both flanges of the keel angles should be countersunk. Great care should be taken in countersinking the vertical keel; for this being part of the centerline bulkhead, the rivets are driven from alternate sides in adjacent tanks, and hence the countersinking alternates. Thus in No. 1 tank the rivets will be driven from the starboard side, in No. 2 tank from the port side, and so on, aft, alternating. The side from which the rivets are driven and calked is called the calking side, and this side is countersunk. The calking side alternates in order to facilitate tank testing and also in order to equalize the weight better.

After the keel is laid the universal bottom shell, i. e., where the ship's bottom is flat, is placed in position on the spauls, and the bottom shell longitudinals or frames can also be put in place, but it is important not to bolt up any of this work until the bulkheads and transverses have been shipped. These bottom shell longitudinals are heavy 12-inch channels, or in large ships they may be built up of 15-inch plates, with top and bottom angles. If built up they are riveted on the ground before shipping, except the rivets directly in way of transverse frames, which should be omitted on the ground. In way of skin strakes of shell plating the shell longitudinals have to be offset to take the butt-laps of the shell; but in way of outside strakes the longitudinals are run straight across the butt-laps and tapered liners are used. Shell holes are omitted where the longitudinals cross the shell butt-laps. When the shell longitudinals have a decided curvature they should be offset before they are bent, as the curvature may prevent their entering the joggling machine.

The next step is to assemble on the ground and put in the ship the transverse oiltight bulkheads. These are in reality half bulkheads, being cut in the middle by the centerline bulkhead, which is continuous. The bulkheads are just the shape of the main oil tanks, but do not extend through the summer tanks, except the end cofferdam bulkheads, which are merely watertight. The bulkheads are plated with horizontal strakes, which permit a decrease in the thickness of plating toward the top as the pressure due to the head of oil decreases. Generally the plating can extend in one piece from the centerline to the shell.

The bounding angles are always double, single-riveted, countersunk in both flanges. The long shell bounding bars, extending around the turn of the bilge, are so unwieldy to handle in the shop that it is often advisable to countersink the shell flange on the skids.

Bounding bars are strapped at the butts, never lapped. This is because offsets in oiltight work are very undesirable, causing expensive anglesmith work and being very difficult to make tight, often requiring a "Dutchman" to fill in where the offset is not neat enough. For this reason shell bounding angles are not offset at the outside strakes of shell plating, but parallel liners are used.

These liners are rectangular and take one row of holes outside the toe of the bar on each side. These holes are countersunk. The liner must fit neatly against the edges of the skin shell plates, and should be in place on the bottom shell befoe the bulkheads are shipped or the shell bolted. The liners under the bulkheads on the flat keel are scarfed, if the thickness of the garboard is different from that of the keel angle. If this is the case, it is important to get these liners in ahead of the bulkheads. If the garboard or other strake is a clinker strake, a long tapered liner is used, which in this case does not extend beyond the toe of the bounding angles.

The bulkhead plating should not be joggled, but worked "in and out," with parallel liners between it and the bounding bars. The bounding angles can be riveted to the bulkhead on the skids, except the centerline bars and the staples at the corners of the bulkhead, which are left loose in case any fairing or regulating is necessary in the ship.

The clips, or "lugs," for the connection of brackets for longitudinals should be riveted to the bulkhead on the skids. These clips should be cut at least 1 inch slack from the toe of the bounding angles for calking, and should also be kept clear of the calking edges of seams of bulkhead plating, if possible. The brackets should not be put on the clips on the ground, as they would have to be taken down again to rivet the bounding bars in the ship.

The bulkheads are assembled on the skids with the calking side up, and the stiffeners will therefore be on the under side. The stiffeners run horizontally and are usually of bulb angle, heel up, and can be riveted to the bulkhead complete. The outboard end of the stiffener takes the bracket for the side shell longitudinal, which is normal to the shell, and it is often necessary to knuckle the bracket on this account. The stiffener, therefore, should end short of the toe of the longitudinal. The lowest stiffener should come well above the turn of the bilge on this account, and below this the bulkhead is stiffened by heavy vertical clips and brackets connecting to the bottom shell longitudinals.

(To be concluded)

Programme for Naval Architects' Annual Meeting

The final list of papers for the twenty-second annual meeting of the Society of Naval Architects and Marine Engineers, to be held at 29 West Thirty-ninth street, New York, on December 10 and 11, is as follows:

THURSDAY, DECEMBER 10

1. "International Conference on Safety at Sea." By Hon. E. T. Chamberlain.

2. "Safety of Life at Sea. Application of Subdivision Rules Adopted at International Conference." By Mr. James Donald.

3. "Safety of Life from Fire at Sea." By Mr. W. O. Teague.

4. "Launching Data for a Battleship." By Naval Constructor J. G. Tawresey, U. S. N.

5. "Stability of Vessels as Affected by Damage Due to Collision." By Mr. William Gatewood.

6. "Expansion or Contraction of Certain Dimensions and the Effect upon Resistance." By Professor H. C. Sadler.

7. "Some Experiments with Models Having Radical Variations of After Sections." By Naval Constructor D. W. Taylor, U. S. N.

FRIDAY, DECEMBER 11

8. "Recent Developments in Submarine Signaling." By Mr. J. B. Millet.

9. "The Thermodynamics of the Marine Oil Engine." By Mr. John F. Wentworth.

10. "Refueling of Warships at Sea." By Mr. Spencer Miller.

11. "Our First Frigates. Some Unpublished Facts About Their Construction." By Hon. F. D. Roosevelt, Assistant Secretary of the Navy.

12. "The Behavior of Riveted Joints under Stresses." Mr. James E. Howard.

14. "The Application of Electric Propulsion to Battleships, together With the Experience Gained in the *Jupiter*." By Lieutenant S. M. Robinson, U. S. N.

15. "Submarine Signalling and a Proposed Method of Safe Navigation in Fog." By Commander F. L. Sawyer, U. S. N.

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S. S. Great Northern and Northern Pacific

New 23-Knot Turbine Passenger Ships Built at Cramp's for the Spokane, Portland & Seattle Railway Company

Two of the finest ocean-going express steamships ever built in the United States are the *Great Northern* and *Northern Pacific,* now nearing completion at the yards of the William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa. These vessels have been constructed to the order of the Spokane, Portland & Seattle Railway Company for service on the Pacific coast between Astoria, Ore., and San Francisco, Cal. Designed for a speed of 23 knots with a capacity for 856 passengers and 2,185 tons of freight, they will, under favorable conditions, make the passage from Astoria to San Francisco in from 25 to 26 hours, equaling the time now required for traveling by the overland route from Portland, Ore., to San Francisco, and thus establishing a direct route from the East to San Francisco over the Great Northern railway lines.

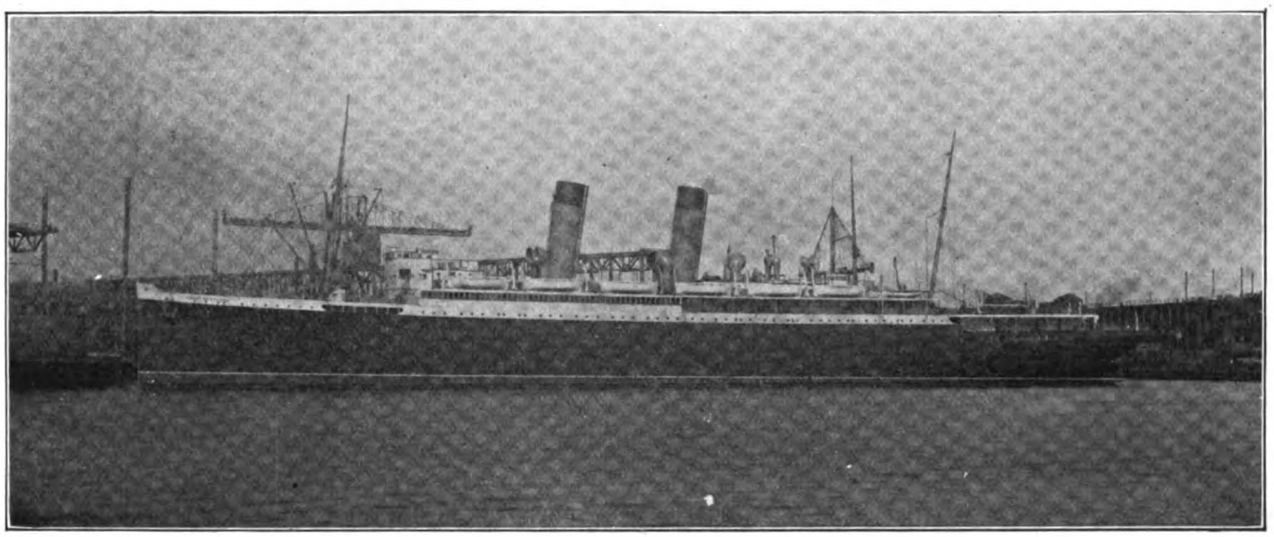

Fig. 1.—Steamship *Great Northern* Fitting Out at Cramp's Shipyard

The Astoria terminal of the line is situated at a point about four miles from Astoria down the Columbia River, where the Spokane, Portland & Seattle Railway Company is building a new pier 600 feet long on which is a single story shed 80 feet wide. The railway tracks run directly on to the pier, and adjacent to the pier is ample space for a freight and storage yard. The maximum fall of tide at this point is 9 feet, and as the new ships will be loaded mainly through side ports, inclined elevators will be provided for the rapid handling of freight between the ships and the pier. At San Francisco, where the fall of tide is 6 feet, one of the State-owned piers has been leased, and this also will be provided with similar facilities for the rapid handling of freight.

To meet the exacting requirements of this service, which calls for high speed, safety, reliability, and at the same time luxurious appointments, the new vessels have been designed on lines closely resembling those of a finely modeled steam yacht. Speed, strength and seaworthiness are apparent to the experienced eye at a glance. The graceful lines of the hull, the ample freeboard and well protected decks are thoroughly in keeping with the characteristics commonly associated with an ocean greyhound, and a careful study of the details of the vessels will show that in the design of both hull and machinery no effort has been spared to make the new flyers among the finest specimens of their type ever turned out from an American shipyard.

Classed A 100 in accordance with the rules of the British Lloyds, the *Great Northern* and *Northern Pacific* are also equipped to pass the laws now in force by the United States Steamboat Inspection Service. This inspection was required by the builders, and is to be made at their yard before the vessels are delivered. The contract for their construction was signed April 26, 1913, the keel of the *Great Northern* was laid September 22, 1913, and that of the *Northern Pacific* September 23, 1913. The *Great Northern* was launched July 7, 1914, and the *Northern Pacific* on October 17, 1914. The first vessel will be given her official trials early in December and will leave for the Pacific coast about the middle of January. The second vessel will follow shortly afterwards and their regular service between Astoria and San Francisco will be begun in March. The construction of the vessels was carried out under the supervision of Mr. C. C. Lacey, marine superintendent of the Great Northern Steamship Company, while their design was worked out in accordance with suggestions from the representatives of the owners by the staff at the Cramp shipyard under the direction of Mr. W. A. Dobson, naval architect, and Mr. J. F. Metten, chief engineer.

The main particulars of the vessels are as follows: Length overall, 524 feet; length between perpendiculars, 500 feet; beam, 63 feet; depth, molded to A deck, 50 feet 8 inches; draft, full load, 21 feet; deadweight carrying capacity, 2,185 tons; cubic cargo capacity, approximately 200,000 cubic feet; shaft horsepower, 25,000; speed, 23 knots; passengers, first class 550, second class 108, third class 198; total passengers, 856; crew, 198; total on board, 1,054; gross tonnage, 8,255.

The *Great Northern* and *Northern Pacific* are the largest turbine-driven passenger ships so far constructed in the

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United States. To obtain the necessary power for a speed of 23 knots on the limits of space and weight available for the propelling machinery, Parsons turbines arranged on three shafts supplied with steam from twelve specially designed Babcock & Wilcox oil-fired watertube boilers were adopted. The contract specifies, however, that the ships shall maintain their designed speed of 23 knots when using steam from only ten of the boilers, the other two standing by as spares.

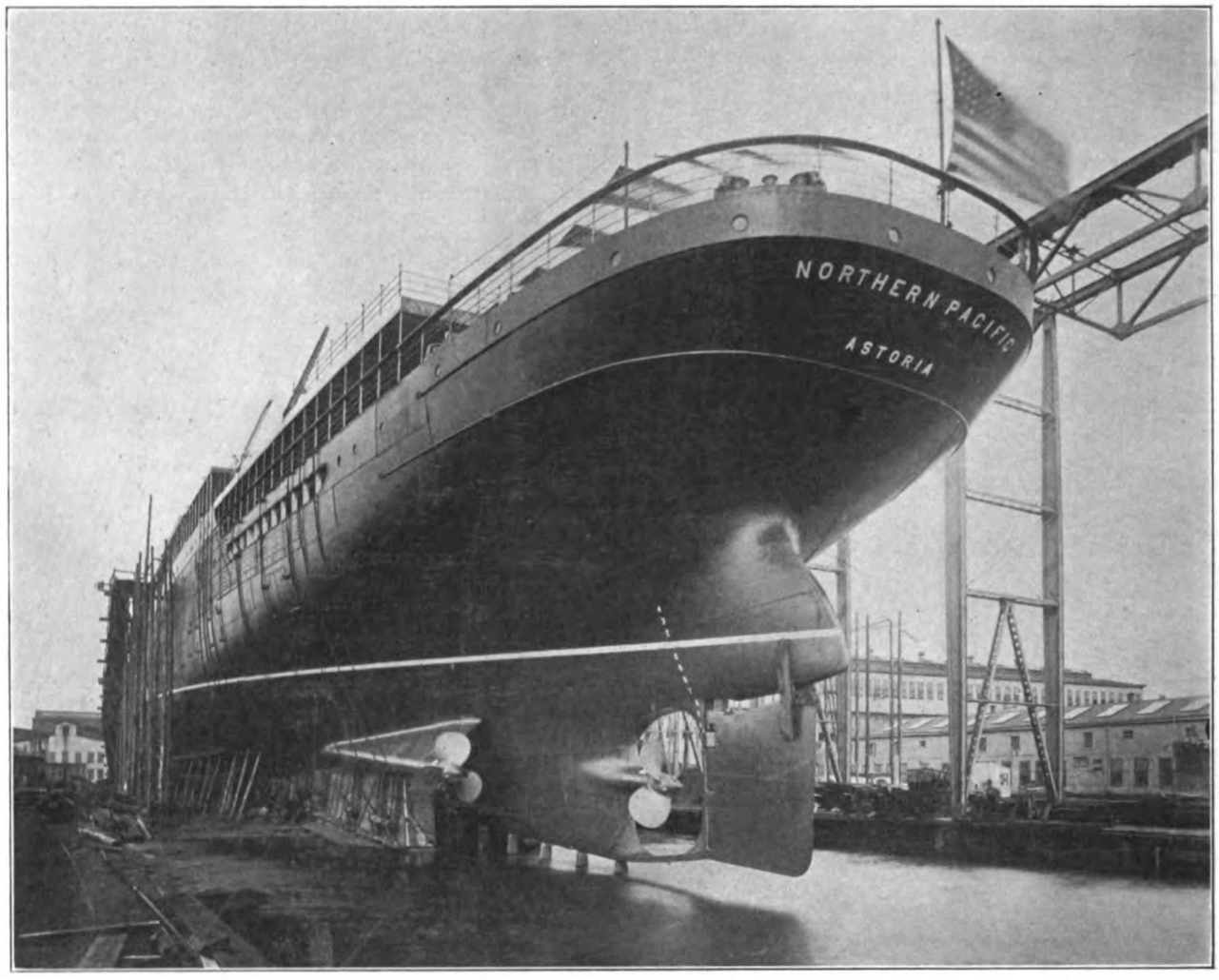

Fig. 2.—Stern View of the *Northern Pacific* Before Launching on October 17

In addition to a cellular double bottom extending throughout the length of the vessel, each ship is subdivided into eleven watertight compartments by ten transverse watertight bulkheads, all of which, with the exception of those in way of the first class dining-room amidships, extend up to the second deck above the load waterline, or a distance of fully fourteen feet above the load waterline. Abreast of the boilers extending through two of the largest compartments amidships are longitudinal bulkheads, forming wing tanks for carrying fuel oil. How effectively this subdivision of the hull protects the vessel from foundering in case of flooding either the first three or any two other adjacent compartments in the ship from a collision or other accident is shown by the diagrams in Fig. 7.

These diagrams have been developed for the ship in a mean loaded condition—that is, at 20 feet 6 inches molded draft, corresponding approximately to that of the ship arriving at the northern terminal of the line with a full cargo, including passengers and baggage, and with about half of the fuel oil, half of the reserve feed water and all the stores, provisions, etc., consumed. The inner bottom, shaft alley and fuel oil tanks are considered bilged with the compartments of which they form a part. The following percentages have been deducted from the molded volume of the various compartments to allow for the water excluding portion of their contents:

	Percent
Compartment No. 1	3
Compartments Nos. 2, 3, 4, 9 and 10	30
Compartments Nos. 5, 6, 7 and 8	5
Compartment No. 11	4

With the vessel intact the metacentric height equals 25 inches. The stability in damaged condition as shown in the diagrams in Fig. 7 is given in the following table:

Compartments 1 and 2 bilged	M-G = + 31 inches
Compartments 1, 2 and 3 bilged	M-G = + 30 inches
Compartments 3 and 4 bilged	M-G = + 30 inches
Compartments 4 and 5 bilged	M-G = + 1 inch
Compartments 5 and 6 bilged	M-G = + 25 inches
Compartments 6 and 7 bilged	M-G = — 12 inches
Compartments 7 and 8 bilged	M-G = + 15 inches
Compartments 8 and 9 bilged	M-G = + 17 inches
Compartments 9 and 10 bilged	M-G = + 11 inches
Compartments 10 and 11 bilged	M-G = + 11 inches

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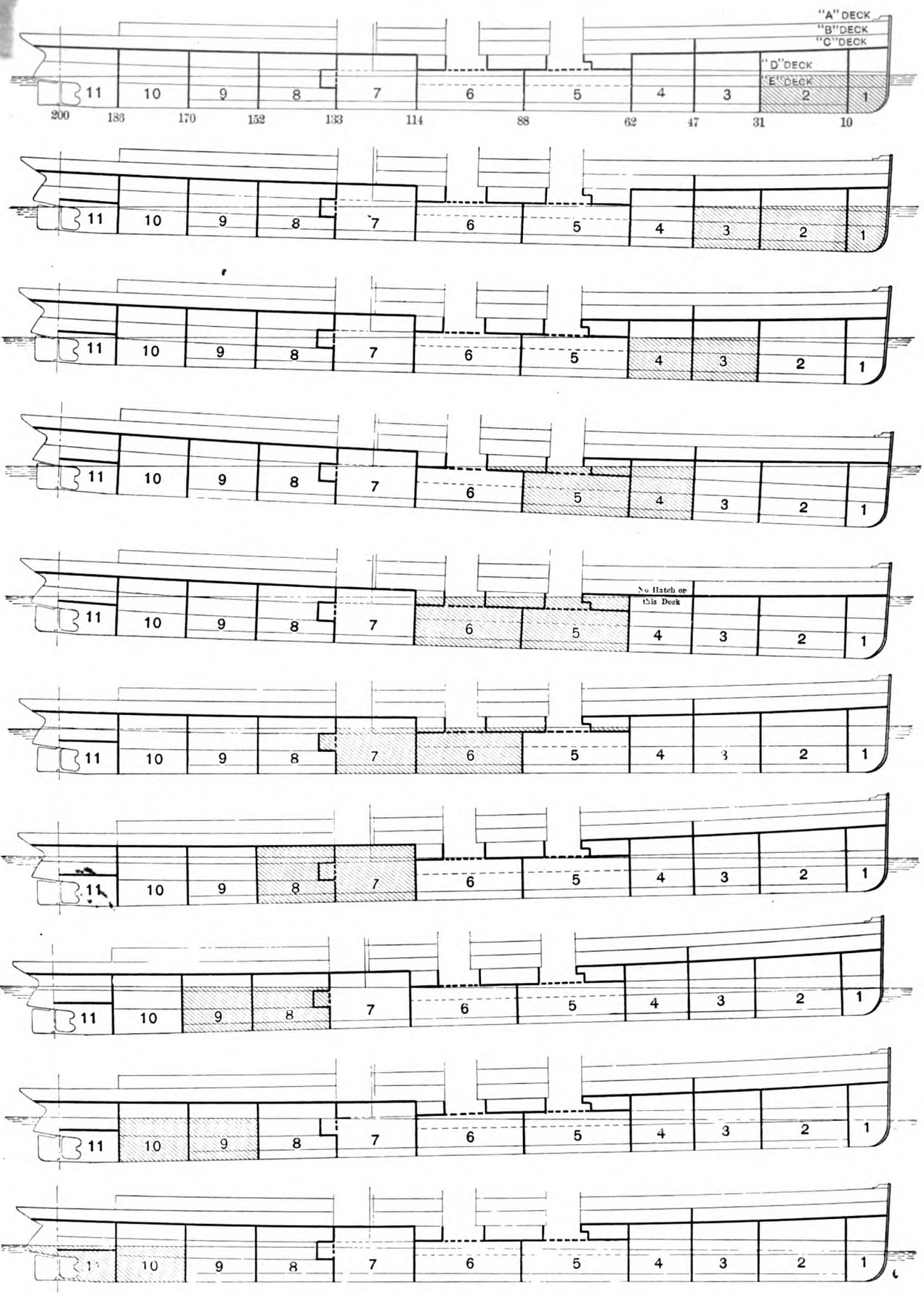

Fig. 7.—Diagrams, Showing Trim With Any Two Adjacent Compartments Flooded

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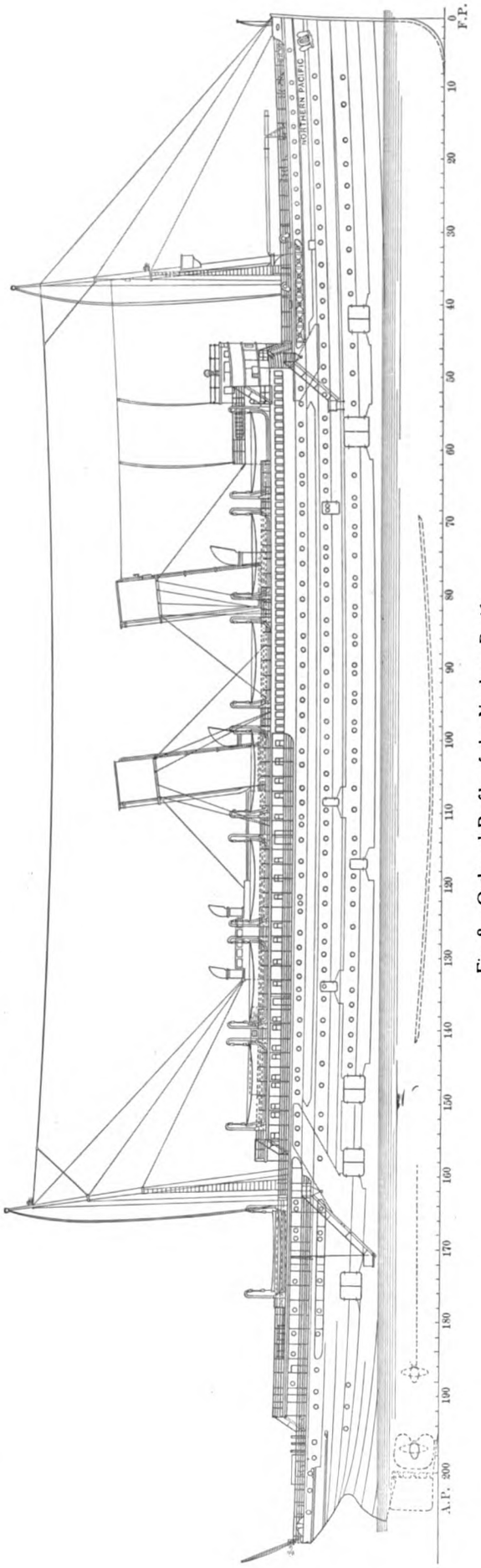

Fig. 8.—Outboard Profile of the *Northern Pacific*

In the ten watertight bulkheads there are no doors below D deck (the first deck above the load waterline) except to the shaft alley and firerooms. Above D deck, where necessary, the bulkheads are fitted with horizontal watertight hydraulically operated doors of the Stone Lloyd type. The doors to the shaft alleys are operated from the working platform in the engine room. Partial watertight bulkheads are fitted in the deep oil tanks alongside the boilers and between the forward boiler room bulkhead and the after engine room bulkhead the D deck is a watertight flat. The longitudinal bulkheads in the boiler rooms are made oiltight up to E deck, and from E deck to D deck they are watertight.

General Arrangement

In profile the vessels have straight stems, slightly raking forward, and semi-elliptical sterns. At the waterline the stern is extended aft to provide for a greater length of load line. The cellular double bottom four feet deep extending fore and aft is available for carrying fuel oil or water ballast.

Above the tank top there are six decks, designated from the top down respectively as the boat deck, A (promenade) deck, B (bridge) deck, C (shelter) deck, D (upper) deck and E (second) deck. On the boat deck are the officers' quarters with the pilot house and chart room above, the wireless station and the lifesaving equipment. Amidships on A, B, C and D decks are the first class accommodations. The A deck, which is a flush deck from the stem to the end of the deck house near the stern, is given over to public rooms with the exception of a limited number of single berth staterooms which are reserved for bachelor quarters. The first class staterooms are on B and C decks, together with the other public rooms, while the dining-room, galley, pantry, etc., are on D deck.

The second class accommodations are similarly arranged on B, C and D decks immediately abaft the first class quarters, while the third class quarters are on the same decks forward. The ship's crew is all berthed on C deck, the sailors being forward, the engine room staff amidships abreast the machinery space and the other help aft.

The cargo is handled chiefly through five large side ports on each side of the vessels at the level of the D deck. Space is reserved forward for cargo on D and E decks and in the hold, two trunked hatches leading up to A deck, where they are served by 50-foot cargo booms of five tons capacity on the foremast. An electric elevator is also installed on the D deck forward, serving the decks below. In the cargo space aft, where the freight is handled entirely through side ports, three electric elevators are installed. On E deck directly abaft the machinery space is a cold storage cargo space of about 20,000 cubic feet capacity for the transportation of perishable goods.

Hull Construction

The principal scantlings of the hull are shown on the midship section, Fig. 9. The stem is of rolled steel finished on the forward edge from the light load waterline to the head, and is carried up to take the foremast stay. The lower end of the shoe piece is of cast steel conforming to the shape of the forefoot. The stern frame is also of cast steel. From 15 feet forward of the propeller post the shoe is gradually raised until the lower rudder pintle is 2 feet above the base line, in order to reduce any damage to the rudder if the vessel should ground. The rudder post extends to the top of the transom frames. The rudder plate is of solid cast steel and the stock of forged steel carried up above B deck, where a hand steering gear is fitted to a crosshead carried on the stock.

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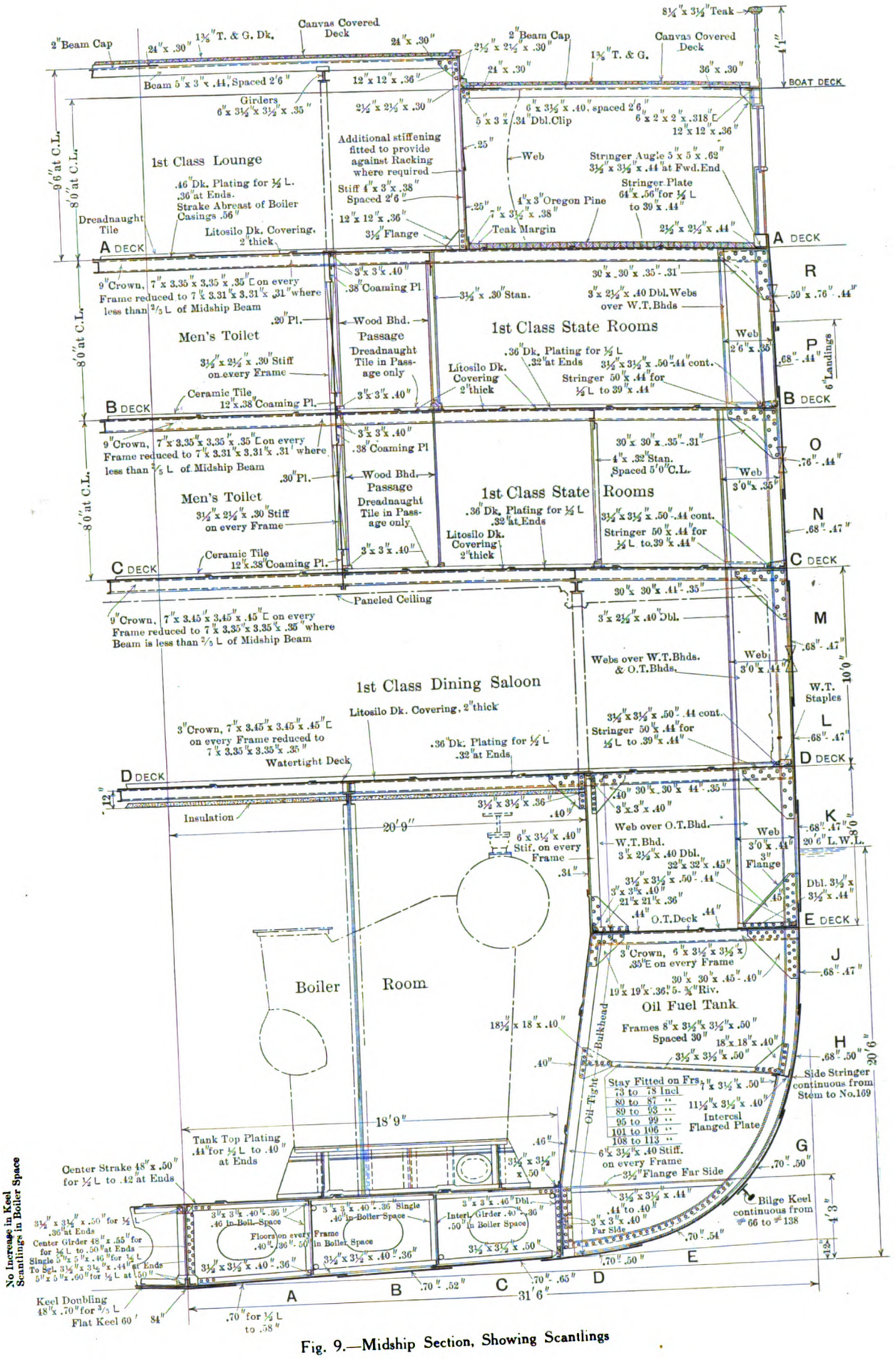

Fig. 9.—Midship Section, Showing Scantlings

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Rudder stops are fitted limiting the movement to 35 degrees.

The flat keel plate is 60 inches wide and .84 inch thick, fitted for three-fifths of its length with a doubling plate 48 inches wide and .70 inch thick. The vertical keel is 48 inches deep by .55 inch thick for one-half length, reduced to .50 inch at the ends. The bottom angles are 5 inches by 5 inches by .60 inch, reduced to .50 inch at the ends, while the upper angles are 3½ inches by 3½ inches by .50 inch for one-half length, reduced to .36 inch at the ends. On each side of the center keel are three intercostal longitudinals, the floors placed on every frame extending in one piece from the vertical keel to the bilge. Above the double bottom or between the margin of the inner bottom and E deck there is a longitudinal bulkhead on each side extending from the forward engine room bulkhead to the forward boiler room bulkhead. Below E deck these bulkheads are oiltight and above E deck they are watertight. The capacity of the wing tanks thus formed is 5 percent in excess of the amount of oil to be carried in order to allow for expansion.

The framing consists of 8-inch by 3½-inch by 3½-inch by .50-inch channels spaced 30 inches amidships and 28 inches at the forward end. The frames extend in one piece from the inner bottom to A deck from the stem to the after limits of the strength deck and aft of that they extend to B deck only.

The A deck is a strength deck for one-half the length amidships and is completely plated within these limits. At the limits of the strength deck structure the stresses are transmitted to the deck below by doubling up the side and deck plating and by diaphragm plates fitted between A and B decks. B, C and D decks are completely plated. The deck beams on A and B decks are 7-inch by 3.35-inch by 3.35-inch by .35-inch channels placed on every frame and reduced to 7 inches by 3.31 inches by 3.31 inches by .31 inch where the beams are less than three-fifths the length of the midship beam. On C and D decks the beams are 7 inches by 3.45 inches by 3.45 inches by .45 inch placed on every frame and reduced as above to 7 inches by 3.35 inches by 3.35 inches by .35 inch. On E deck the beams are 6-inch by 3.5-inch by 3.5-inch by .35-inch channels placed on every frame.

The shell plating, as shown in Fig. 9, varies from .76 inch in the sheer strakes at A and B decks to .68 inch in the side plating, the bottom plating being .70 inch thick.

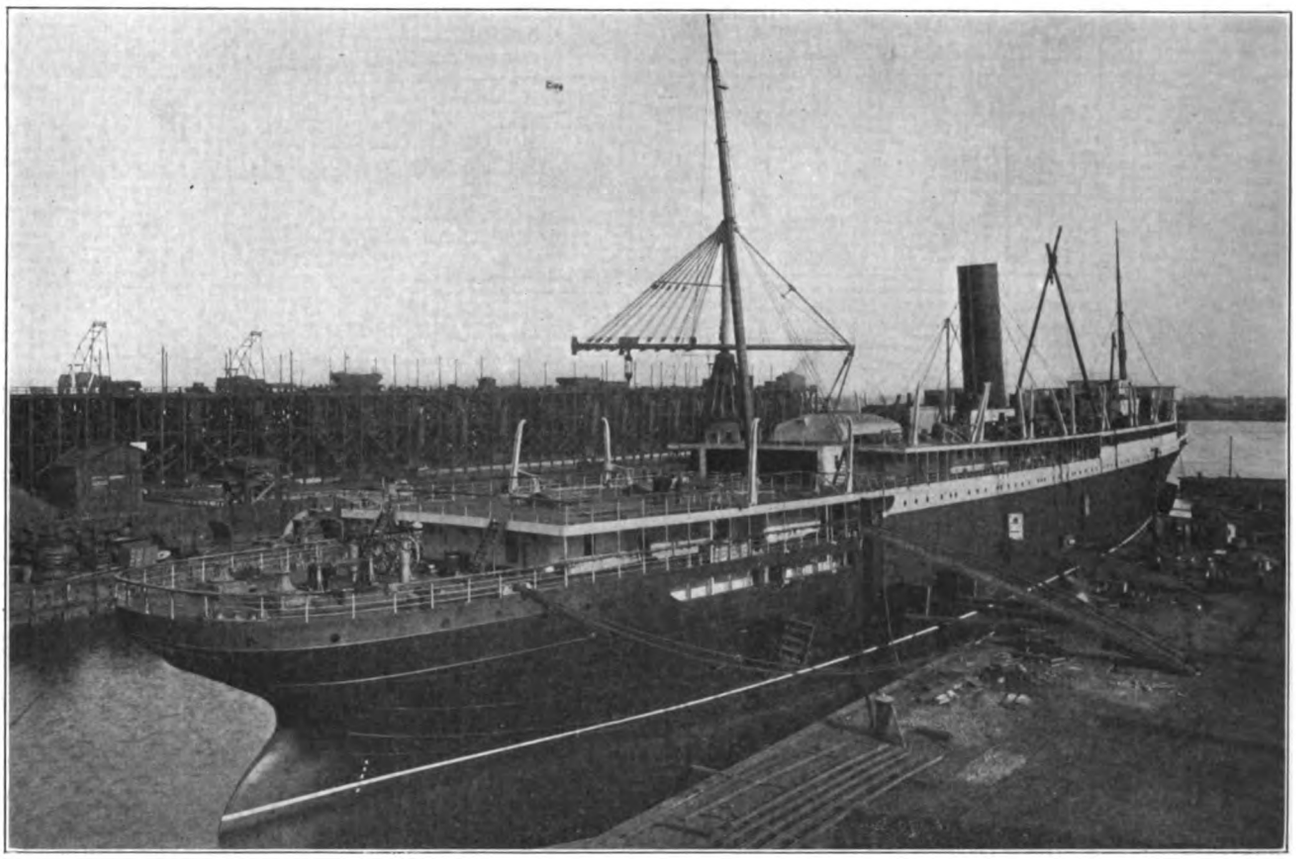

Fig. 10.—View of the *Great Northern*, Taken at the Fitting Out Dock, September 14

Boilers

Steam is supplied at 220 pounds per square inch working pressure by twelve specially designed watertube boilers of the Mosher type, built by the Babcock & Wilcox Company to the requirements of the United States Board of Supervising Inspectors, and also to Lloyds inspection. The twelve boilers are installed in two watertight compartments, in each of which the boilers are arranged in rows of three facing the center line of the ship, and thus providing a fore and aft fireroom 11 feet 2½ inches wide by 65 feet long. The total space occupied by the boilers is therefore 130 feet by 41 feet 6 inches.

The overall dimensions of the boilers are: Width, 15 feet 7⅜ inches; length, 11 feet 8 7/16 inches, and height over the steam drums, 14 feet 2½ inches. Each boiler contains approximately 5,000 square feet of heating surface, making the total heating surface for the vessel about 60,000 square feet. The steam drums are 54 inches diameter with the heads bumped to a radius of 54 inches and flanged by hydraulic pressure. The water drums are oval in shape. Each boiler has 969 generating tubes 2 inches

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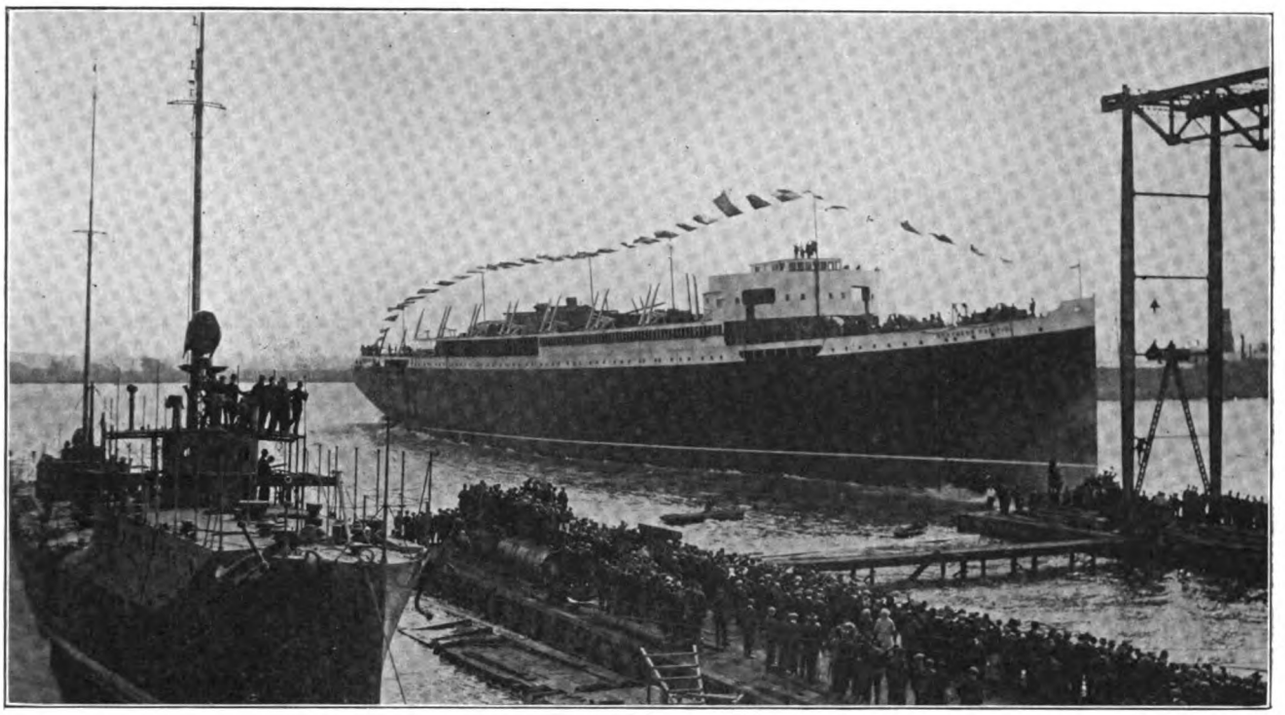

Fig. 11.—Launch of the *Northern Pacific*

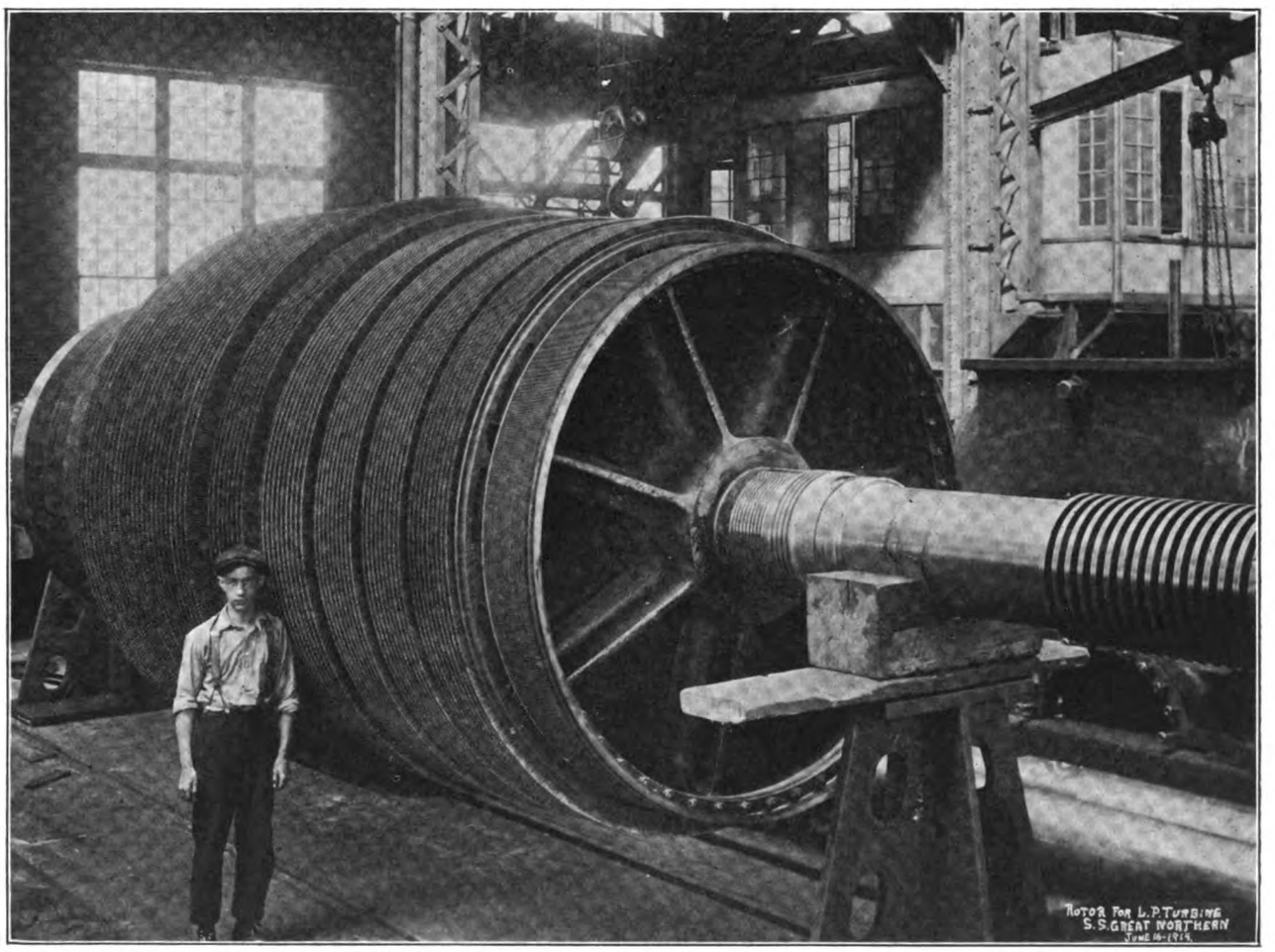

Fig. 12.—Rotor of Low-Pressure Turbine for the *Great Northern*

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in diameter of No. 9 B. W. G. They are given a straight curvature and are expanded into the steam and water drums.

The boilers operate under forced draft on the closed stoke-hold system. Three turbo blowers, manufactured by the B. F. Sturtevant Company, Hyde Park, Mass., are installed in each fireroom. The turbines are direct connected to 34-inch high speed cone fans and each unit delivers 30,000 cubic feet of air per minute against a pressure of 2 inches of water. The units will operate at 180 pounds steam pressure and are equipped with emergency safety governors. Two of the units in each fireroom are sufficient to supply the draft at a speed of 23 knots, the third unit being reserved as a spare. A watertight door connects the forward and after firerooms and the after fireroom also communicates with the engine room by means of a watertight door.

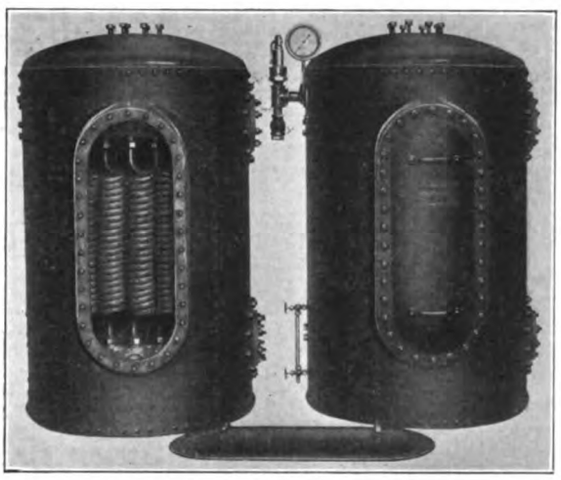

Fig. 13.—Reilly Multi-Coil Feed Water Heater

The Koerting mechanical oil burning system, supplied by Schutte & Koerting Company, Philadelphia, Pa., is used for firing the boilers. In this system the oil is forced by means of pumps through superheaters to the burners, where it is atomized by mechanical action. For the purpose of transferring the oil from the storage tanks and putting it under a constant steady pressure, the system is equipped with a pumping outfit consisting of two steam driven pumps, an air chamber and all necessary valves and fittings. One of the pumps is always kept in reserve in the event of mishap to the other, thus insuring practically uninterrupted service.

The oil is taken from the storage tanks and on its way to the pump passes through duplex suction strainers. The pump puts the oil under the required pressure, a large air chamber being provided to take up the pulsations of the pump, and then passes through a superheater using live steam to heat the oil to the proper temperature. Evaporation of the oil is prevented by the pressure on the pumps being kept in accordance with the temperature. On the way from the superheater to the burners, the oil, which is then under high pressure and of the required high temperature, is again strained in a high-pressure duplex strainer. The burners are of the centrifugal spray type fastened to adjustable air registers provided with air admission slides to regulate the air supplied for combustion, so as to secure a proper mixture of air and oil for complete combustion. No steam or air is required for atomizing the oil, as the moment the oil leaves the spray nozzles the pressure is removed and the oil is thoroughly atomized and mixed with the incoming air.

It is obvious that the use of oil fuel, thus eliminating the trimming of coal and the method of installing the boilers in a fore and aft fireroom which is made possible by the adaptability of the boilers to be set athwartship, provide an extremely compact and accessible boiler arrangement for a plant of this size. The products of combustion are taken off by two smokestacks about 112 feet high above the base line, each group of six boilers being connected by suitable uptakes to a single stack.

Main Engines

The propelling machinery consists of one high-pressure and two low-pressure Parsons turbines arranged on three shafts and capable of developing a total of about 25,000 shaft horsepower at 325 revolutions per minute. Steam from the boilers is supplied through two main pipes connecting to the inlet belt of the high-pressure turbine on the center shaft, and also to the inlets of the two low-pressure turbines on the wing shafts for maneuvering purposes. Astern turbines are incorporated in each of the low-pressure turbines and the steam connection to the astern turbines and the low-pressure ahead turbines lead from a double maneuvering throttle at the working platform so arranged that in maneuvering ahead or astern both valves will be operated from a hand wheel. The main steam connection to the high-pressure turbine is controlled with a single balanced throttle valve at the working platform.

The high-pressure turbine is 21 feet 7½ inches long overall, the outside diameter of the drum of the rotor being 5 feet 8 inches. The cylinder is of close-grained cast iron and the rotor drum an open hearth weldless steel forging. The wheels are of cast steel annealed and the shaft of open hearth forged steel. There are four stages of expansion with sixteen rows of blading in each stage, the diameters of the rotor at the tips of the blades of each stage being respectively 5 feet 11 inches, 6 feet ¼ inch, 6 feet 2 inches and 6 feet 4½ inches.

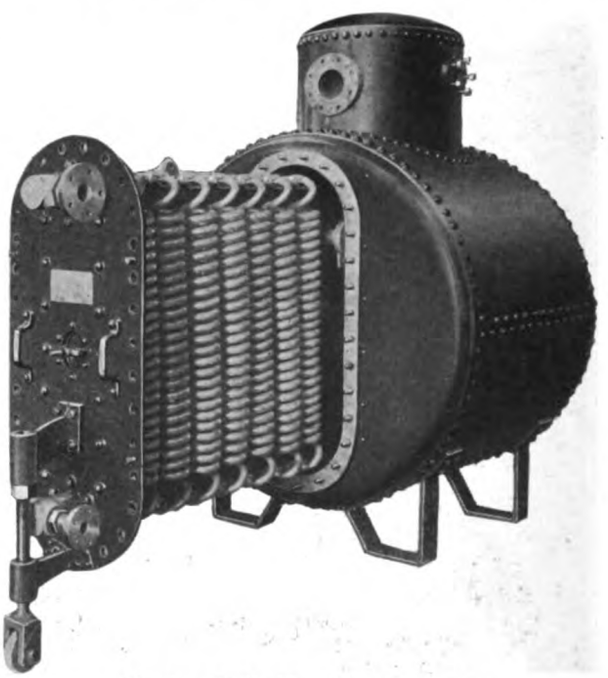

Fig. 14.—Reilly Navy Type Evaporator

The total length of each of the low-pressure ahead and the astern turbines is 32 feet 2 inches, the low-pressure drum being 7 feet 8 inches outside diameter and the astern

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drum 6 feet 7 inches diameter. There are six stages of expansion in the low-pressure turbines and four stages in the astern turbines.

The construction of the turbines conforms to the latest Parsons practice in every respect. The line shafting is 12¼ inches diameter. Lubrication of the turbine thrust and spring bearings is by oil supplied by a gravity tank of 2,000 gallons capacity so placed as to give a pressure at the bearings of 10 pounds per square inch. This tank is supplied by two steam-driven pumps which draw from the inner bottom or from drain tanks. Two oil coolers of the quadruple flow type, having a cooling surface of about 360 square feet, are installed in the engine room for cooling the main engine lubricating oil. The circulating water is taken from the oil cooler circulating pump with emergency connections from the fire and bilge pumps or the main circulating pumps.

The two main condensers each have 13,046 square feet of cooling surface and contain 6,018 tubes ¾-inch diameter and 11 feet long between tube sheets, with a thickness of No. 16 B. W. G. An auxiliary condenser is provided for port use. There is one air pump for each condenser of the twin beam, vertical, single-acting type, supplied by the Blake & Knowles Steam Pump Works, with air cylinders 32 inches diameter and steam cylinders 14 inches diameter with a stroke of 21 inches. The auxiliary air pump is of the vertical simplex featherweight type 7½ inches by 14 inches by 10 inches. The cooling water for each condenser is supplied by a 26-inch engine-driven centrifugal pump.

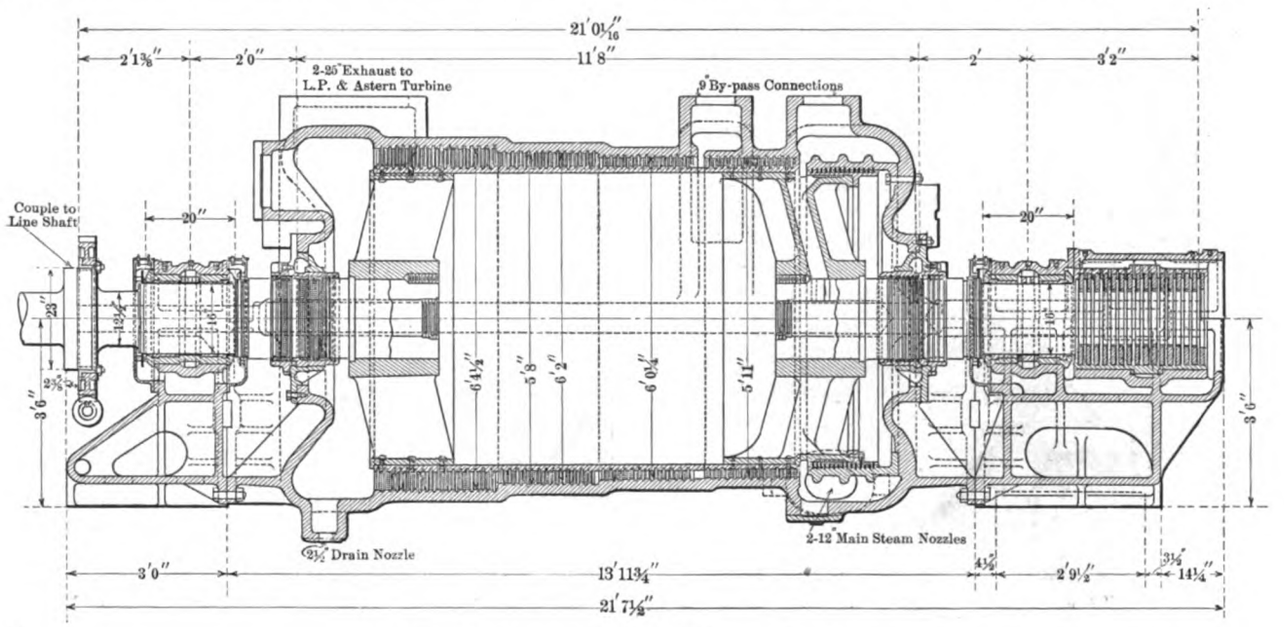

Fig. 15.—Section Through High-Pressure Turbine

Auxiliaries

The following pumps were furnished by the Blake & Knowles Steam Pump Works:

Four main feed, vertical simplex, Weir type, 15½ inches by 9¾ inches by 24 inches.

Two auxiliary feed, vertical duplex, 12 inches by 8½ inches by 12 inches.

Two bilge and ballast, vertical duplex, 7½ inches by 9 inches by 10 inches.

Two lubricating oil, vertical simplex, 6 inches by 8 inches by 12 inches.

Four fuel oil service, horizontal duplex, 7½ inches by 5 inches by 10 inches.

Two oil transfer, vertical simplex, 6 inches by 8 inches by 12 inches.

Two brine, vertical duplex, 5¼ inches by 5 inches by 5 inches.

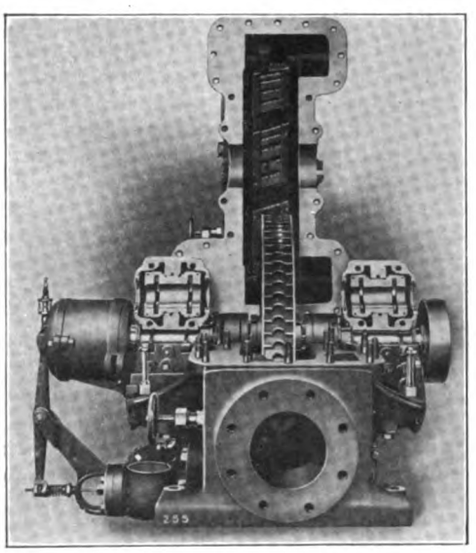

Fig. 16.—Terry Turbine Opened for Inspection

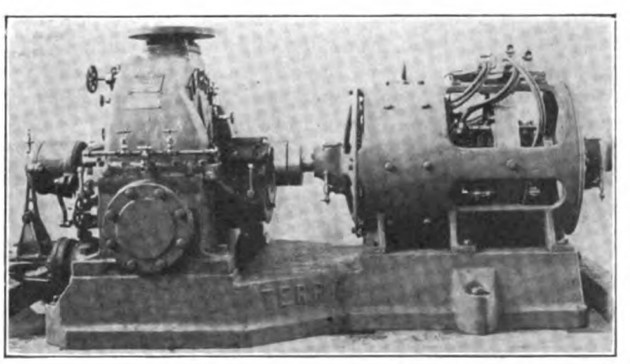

Fig. 17.—Terry Turbo Generating Set

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One donkey boiler feed, horizontal simplex, 4½ inches by 2¾ inches by 6 inches.

One evaporator feed, horizontal simplex, 4½ inches by 2¾ inches by 6 inches.

Two fresh water, horizontal simplex, 5½ inches by 5½ inches by 7 inches.

One ice water circulating, horizontal simplex, 3½ inches by 3½ inches by 4 inches.

The auxiliaries also include two 4-inch Worthington centrifugal sanitary pumps designed to handle 500 gallons of salt water per minute for sanitary purposes against a head of 100 feet. These pumps are driven by a standard Terry type "Z" turbine, delivering about 20 horsepower at 2,750 revolutions per minute and designed to operate with normal steam conditions of 175 pounds initial pressure and 10 pounds back pressure, although the turbines

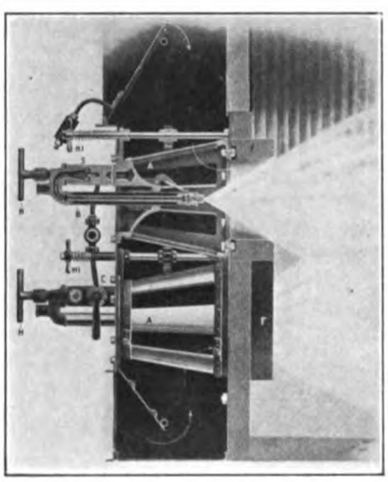

Fig. 18.—Koerting Mechanical Oil Burner Installed in the Boilers

are capable of delivering the required horsepower with 220 pounds initial steam pressure and 5 pounds back pressure.

The feed water heaters, of which there are two, are of the Reilly multicoil type furnished by the Griscom-Russell Company, New York. They are 48 inches diameter by about 7 feet high. Each of these heaters can handle 150,000 pounds of feed water per hour to a discharge temperature of 208 degrees F. when furnished with steam at 5 pounds pressure. The shell is of boiler steel with the door frame and door of pressed steel. The heating element consists of seamless drawn copper tubing free from brazing and gaskets, the connections being made of the manufacturers' patented copper-faced union joint.

Another auxiliary furnished by the Griscom-Russell Company is a Reilly multicoil horizontal Navy type evaporator 4 feet 4 inches diameter and 6 feet 7 inches high, capable of furnishing 25 tons of pure distilled water per twenty-four hours. The shell, heads, door and dome are of open hearth steel, the manifolds and heating surface of brass and copper respectively. The heating surface is of the manufacturers' special Navy type copper coils with quick detachable flanged joints.

There is a complete CO_2 refrigerating plant, manufactured by J. & E. Hall Company, Ltd., consisting of two No. 9 machines for refrigerating the cargo holds and ship's stores.

Two hot-water generators are provided, one for heating fresh water and one for salt water service. These are of the straight tube, multipass type manufactured by the Griscom-Russell Company. Each unit has a capacity of 150 gallons of water per minute heated from 50 to 130 degrees F. with steam at 5 pounds pressure. The tube plates are of brass in the salt water heater and steel in the fresh water heater.

Electric Plant

The electric plant consists of four 35 kilowatt 110-volt generators, manufactured by the Diehl Manufacturing Company, direct connected to Terry type "GM" turbines manufactured by the Terry Steam Turbine Company, Hartford, Conn. The turbines themselves are designed to operate normally with 200 pounds steam pressure and a 28-inch vacuum, although they will carry the required load with 175 pounds steam pressure and a 26-inch vacuum, and are capable of operating with an initial pressure of 220 pounds. For emergency purposes they can also be operated with 175 pounds steam pressure when exhausting against a back pressure of 10 pounds. The normal operating speed of these sets is 3,200 revolutions per minute.

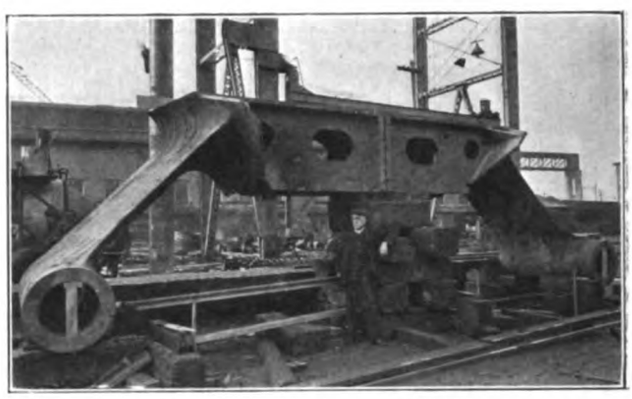

Fig. 19.—Cast Steel Spectacle Frame; Weight 22 Gross Tons

This plant supplies current not only for lighting the ship, but also for operating the five freight elevators and many of the appliances in the galley, as well as for operating a Willets-Bruce automatic whistle with which these vessels are equipped.

Passenger Accommodations

In arranging the passenger accommodations on the *Great Northern* and *Northern Pacific* the needs of the patrons of the line have been carefully considered and every feature which could add to their comfort and pleasure has been incorporated. Few modern passenger ships of the same tonnage and type can boast of more commodious promenade decks or of more tastefully decorated or conveniently arranged public and private rooms.

As has been stated before, the A deck is given over almost wholly to the first class public rooms. At the forward end of the superstructure is a curved steel bulkhead or shield which divides the first class quarters from those occupied by the third class passengers and crew and which also serves to protect the passengers from any spray that might come aboard. For this purpose the shield is faced with heavy half-round bars intended to break up a solid wave or diminish its force when breaking over the deck.

For 125 feet aft of this shield the deck is protected by sliding glass windows of the Laycock patent type, so that the passengers can enjoy the deck space for dancing or promenading in all kinds of weather. Within this glass enclosure are the main lounge, observation room and lob-

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bies, all pleasingly decorated and finished in the Colonial style. The color scheme in the observation room is green and old ivory, and in the lounge there are old rose carpets and tapestries. In both rooms there are attractive bay windows on each side fitted with French windows, while skylights overhead aid materially in lighting and ventilating the rooms. In the lounge a large fireplace ready for service adds much to the comfort of the traveler.

Just abaft the observation room is the main entrance and stairway leading to the decks below, while abaft the main lounge alongside the machinery hatches are a number of bachelor staterooms with private toilets and showers between them.

Further aft on A deck is the first class smoking room, the joiner work of which is of oak finished in natural colors. The floors are of Dreadnought tiling of soft, warm colors harmonizing with the russet brown leather furniture and oak joiner work. In this room, as well as in the lounge, there is a large open fireplace ready for service. Just abaft the smoking room is a deck veranda, protected at the sides with glass, but open towards the stern. The furniture on the veranda is of Windsor design.

On the deck below are located special suites of rooms which include parlors, single and double bedrooms, as well as the ordinary first class staterooms. The rooms are equipped with every accessory which a traveler might desire, with public and private bathrooms conveniently arranged. All of the hallways, alcoves and lobbies throughout the passenger quarters are spacious and are covered with Dreadnought tiling and rugs harmonizing with the style and finish of the joiner work. The staterooms are finished in white enamel with doors of mahogany paneling, and are fitted with two berths and a sofa lounge. There are also writing rooms and a barber shop on this deck.

The first class quarters on the C deck consist wholly of staterooms and toilets and bathrooms. The staterooms are of the same order as those on the B deck, although there are no suites. As the main entrance to the first class quarters is on this deck, the purser's office is located forward at the main stairway, which leads down to the main dining-room on the deck below.

The dining-room is most attractively decorated in the Colonial style, with alcoves along the sides of the room. The round port lights are hidden behind white latticed windows and panels on the walls are fitted with large French plate glass mirrors. The flooring here is also covered with Dreadnought tiling. The pantry and galley are immediately aft of the dining-room and are thoroughly ventilated by exhaust fans of sufficient capacity to change the air every two minutes and also to change the air in the dining-room every seven minutes.

The arrangements for the second class passengers are equal to most of the present first class coastwise ships. The staterooms are furnished along the same lines as the first class rooms and the ventilation of these accommodations is part of the same system that ventilates the first class rooms. The heating and ventilating are on the thermo-tank system.

All of the stateroom bulkheads throughout the ships are constructed of "Nevasplit" paneling 7/16 inch thick, supplied by the Keyes Products Company, New York. In all, about 30,000 feet of this paneling was required for both ships. Below the upper or weather deck the decks are covered with from 2 inches to 3 inches of "Litosilo," a composition which adds materially to the sanitary conditions of the passenger quarters, as it does not absorb moisture to the extent of a wood deck, and is thoroughly durable.

FIRE ALARM SYSTEM

One of the most interesting and important of the numerous safety devices installed on these ships is the Aero automatic fire alarm system, which responds to any sudden rise of temperature in the space which it reaches, as was described in our September issue. The layout of the Aero system on these ships differs slightly from the steamship equipments heretofore installed. There are three centers of distribution or switchboards, which are placed on deck C, the locations being forward at the stairways used by the officers and ship's crews, midships in the vicinity of the first class companionway, and aft at the stairway in the second cabin. From these switchboard cabinets the copper tubing circuits radiate, being threaded through the various compartments, staterooms and lockers, returning ultimately to the switchboard, making a complete loop in every instance. One end of the loop is in a sensitive diaphragm which, in the case of fire in the section covered, the air in the tube expanding, moves to the contact point, thus closing the electric circuit. The other end of the tube is connected to a testing valve by which the exact condition of each circuit and all its electric connections can be accurately determined at any time by the officer in charge.

There are two annunciator boards, one in the engine room—a cabinet with a glass front on which is outlined the diagram of the ship—which indicates the exact location on the ship and the deck affected in the case of fire outbreak. A duplicate of this apparatus is placed in the pilot house, so that in the event of fire in any portion of the ship affecting any circuit a general location, whether forward, midships or aft, starboard or port, and the deck, is shown by the indicators. A fire bell in the engine room and a "still alarm" buzzer in the pilot house sound to call attention to the indicators.

The sub-switchboards mentioned in the foregoing each contain a buzzer for a "still alarm," and in the event of fire will call attention of the stewards, officers, or any of the ship's people to that cabinet, where is indicated the exact location of the outbreak. In the event of fire aft affecting the after board, no indication is given in the midships or forward boards, but the main annunciator in the engine room and the duplicate in the pilot house both register. Thus, the same operation takes place should the fire affect the circuits of the midships board or the one forward, No alarm is given on any of the switchboards except the one situated in the area where the fire occurs. This minimizes the danger of panic among either passengers or crew, and as the Aero picks up its alarms "within seconds" of the outbreak, it enables the fire to be dealt with in its incipient stage, and thus extinguished without the necessity of giving a general alarm.

While the installations of the Aero system on shipboard up to date have been mostly on passenger-carrying boats, these Great Northern liners having considerable cargo space are protected throughout, the Aero tubing being run along the steel ceilings in the lap-joint of the steel plates, thus lying out of harm's way and at the same time most advantageously placed for gathering heat effects and responding to the rapid rise of temperature.

DECK AUXILIARIES

The steam steering gear, windlass, capstans and hoisting winches were all supplied by the American Engineering Company, Philadelphia. The steering engine is of the differential type, with cylinders 14 inches diameter by 14 inches stroke, controlled by an automatic reverse valve. The engine can be operated directly at the engine or by telemotor from the pilot house.

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Launching Calculations

Preliminary and Final Curves and Data for Launching Large Vessels

BY G. H. BARBER

The purpose of this article is to set down the procedure of preparing the launching curves and other necessary data required by the builders preparatory to the launching. The methods described are those used by the writer in preparing preliminary and final curves and data for the launching of vessels of from 6,000 to 13,000 tons launching weight. It is thought that the methods and forms used may be of interest and use to those who have similar problems.

Declivity of the Keel

It is desirable to keep the ship as near the ground as possible, giving consideration to leaving ample working space under the keel at the after end and also to seeing that work on the after end is not hindered by the water, thereby preventing excessive heights of the forward and after blocks. The lower the initial position of the ship the greater the buoyancy obtained on a given run, and hence a lesser tendency to overturn about the end of the ways. If the blocks are built at a lesser declivity than the ways the height of the foremost block must be such that the forefoot will not strike the slip.

Assuming a certain launching tide and the end of the groundways fixed, the greater the declivity of the blocks the less the distance run before pivoting and the greater the moment against tipping, but the greater the pivoting pressure and thrust from the groundways.

Declivity of the Ways

With the same launching tide, the greater the declivity of the ways the less is the distance the ship must run after pivoting, but the greater the thrust from the after end of groundways.

The greater the ways' declivity the greater will be the tendency to move down the ways. This, in conjunction with the probable time of year of launching, as affecting the grease and thereby the coefficient of friction, must be considered in connection with the available or intended holding and releasing devices.

A point worth investigating, especially in vessels of great length, is to see that the bottom of the ship at the after end does not dig into the fairway bottom before pivoting takes place. This is done by drawing the ship at the correct slope in position on the ways immediately before pivoting, and then drawing the contour of the sea bottom at correct elevation and see if the clearance under the ship is sufficient. While this is properly remedied by dredging, cases may arise where it is preferable and possible to alter the declivity of the ways.

It is necessary, as a rule, to investigate the launching curves for one declivity of the keel only. If more than one is investigated the work for the second duplicates the procedure for the first. On the other hand, it is usual to investigate for two sets of launching declivities—one being what is considered the maximum limit and the other somewhat less. Assuming then a certain launching declivity, the usual launching curves are obtained as described below and then modified to suit varying tides, launching declivities and weights.

The Distance Between Ways

In this country, where two ways, one on either side of the keel, are used for stern launchings, it is safe to make the distance between ways about one-third of the breadth of the ship. The exact distance is governed by the location of the longitudinal bulkheads or stiffeners, which will transmit and distribute the upward thrust of the ways into the structure. In yards where permanent structures are set up to take the groundways, allowance should be made in the width for a shift, either inboard or outboard, of the centerline of the ways to meet varying fore and aft structural arrangement of the different vessels to be launched.

Locating the Forward and After Poppets

Before proceeding with the launching curves it is necessary to locate the forward poppet. The after poppet will likewise be discussed. There are three considerations which ordinarily make it desirable to locate the fore poppet as far forward as possible.

1. The moment of weight about the fore poppet is increased in a greater proportion than the moment of buoyancy about the same point by so doing. This causes the boat to pivot later in its run, thereby decreasing the pivoting pressure in amount and in duration.

2. A gain in length of sliding way is made. The greater the length of sliding ways available the less width will be required to keep the pressure on the ways per square foot within safe limits. This consideration is very important in the case of battleships where the weight per foot of length is very much greater than that of merchant vessels. Wide ways increase very much the cost of handling and fitting the packing between the sliding ways and ship and removing the same after launching.

3. The "overhang" forward is reduced. This is essential, as the weight of the overhang must be transmitted through the structure to the packing. The structure should not be too greatly strained, nor should too great a weight be concentrated over the forward packing.

Considerations 2 and 3 apply also to the location of the after poppet.

It will be seen that the shape of the vessel forward, the distance between the center lines of ways and the kind of fore poppet to be used will determine the forwardmost point at which the fore poppet can be located.

Locating the End of Groundways

A tentative position for the end of the groundways may be selected by running the groundways, if possible, to the point at which the depth of water over the ways at mean high tide is approximately equal to the probable forward launching draft of the vessel. As the moments about the end of ways are easily obtained changing the location of the end of the groundways, to gain moment against overturning is an easy matter. If there are physical reasons for not extending the groundways, the anti-tipping moment may be increased otherwise, as elsewhere explained.

The Launching Curves

The ultimate purposae of the curves is to ascertain the points of action and the amounts of the static forces acting on the ship during launching. The tendency of the ship to overturn about the after end of the groundways is ascertained, as well as the point of run at which the buoyancy, acting upward about the fore poppet, over-

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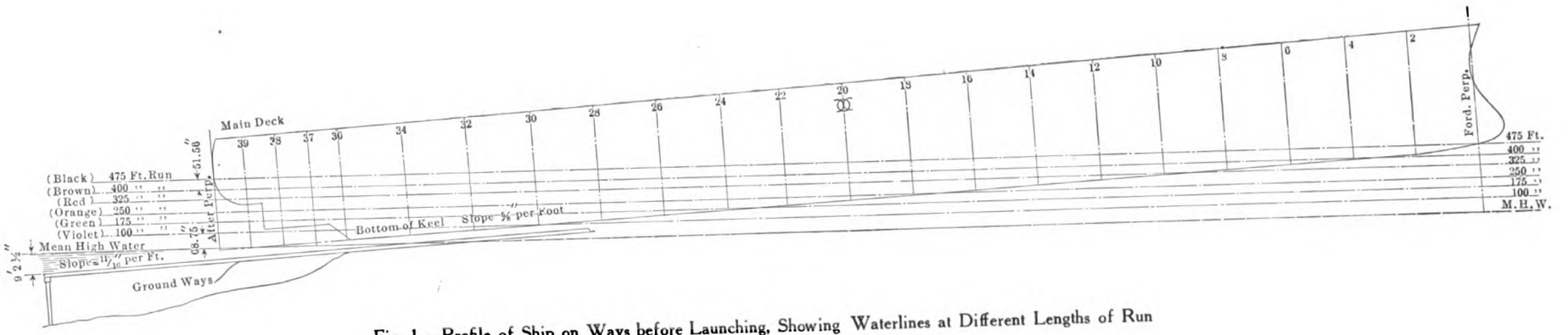

Fig. 1.—Profile of Ship on Ways before Launching, Showing Waterlines at Different Lengths of Run

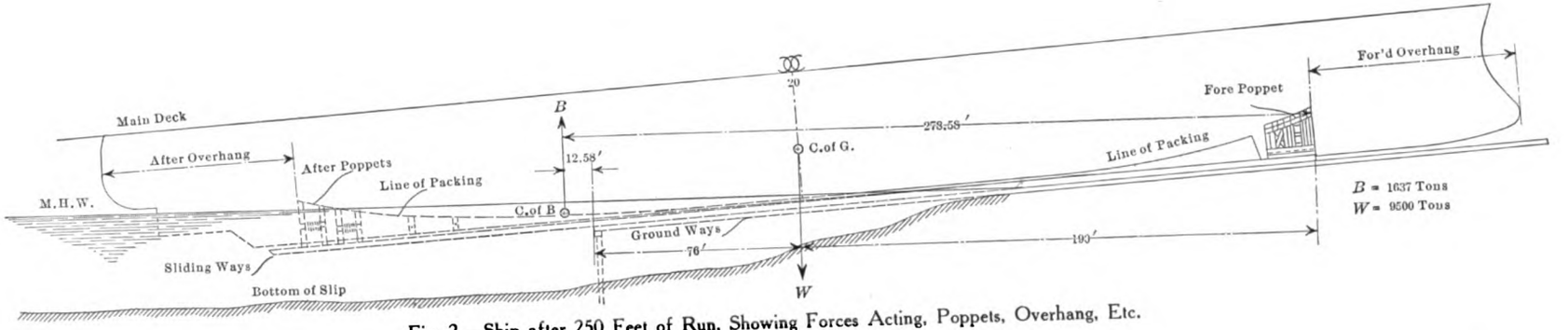

Fig. 2.—Ship after 250 Feet of Run, Showing Forces Acting, Poppets, Overhang, Etc.

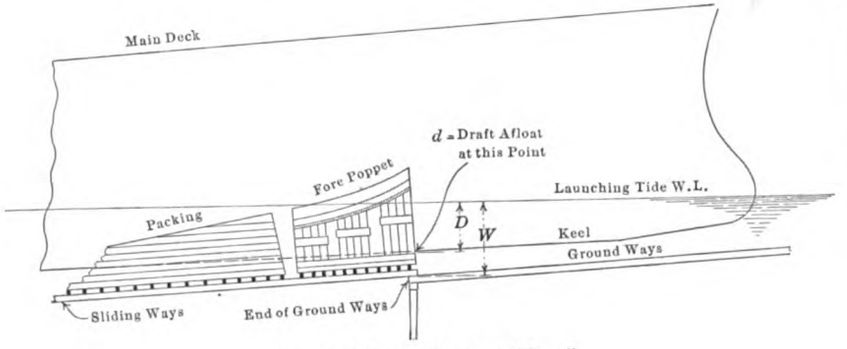

Fig. 3.—Sketch Showing "Drop"

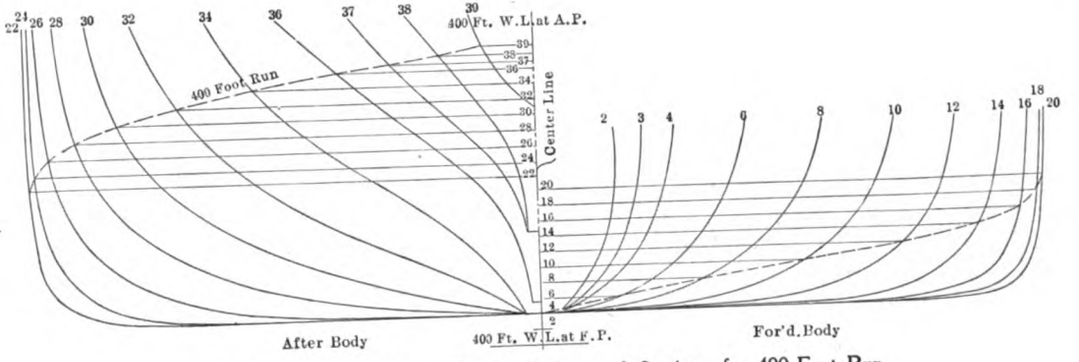

Fig. 4.—Launching Body, Showing Submerged Sections for 400-Foot Run

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comes the weight acting downward about the same point, together with the amount of weight, unsupported except for the fore poppet, at the moment when this turning or pivoting begins.

The curves required are as follows:

A—Weight curve.
B—Inclined displacement or buoyancy.
C—Moment of buoyancy about fore poppet.
D—Moment of buoyancy about after end of ways.
E—Moment of weight about after end of ways.
F—Moment of weight about fore poppet.
G—Reaction of groundways.

These curves are all laid off on the same base of "Distance Run in Feet." The vertical scale for A, B and G is in tons, and for C, D, E and F is in foot tons.

Weight Curves and Weight Moment Curves

The probable launching weight is calculated for those parts of the hull, machinery, fittings, dunnage and ballast which it is estimated will be in place at launching. This is carefully done, the longitudinal center of gravity being determined at the same time. A straight line is then drawn across the curve sheet at the height on the displacement scale corresponding to this weight. Then the position of the center of gravity of the weight being known in respect to the end of the ways and the values for the fore poppet, moment of weight about the fore poppet and about the end of groundways are calculated in foot-tons and the curves are drawn in.

Buoyancy Curve and Buoyancy Moment Curves

The longitudinal profile is drawn at the declivity of the keel blocks and the mean high water line drawn in at its correct elevation relative to the ship in its initial position. For the purposes of these curves it may be assumed that the ship stands still and that the waterline rises at a rate corresponding to the declivity of the ways —i. e., an 80-foot run at 9/16-inch slope equals a rise in the waterline of $9/16 \times 80 = 45$ inches. The designer's even numbered stations are now drawn in the profile and a body plan using these stations is made to a convenient scale. Waterlines corresponding to runs of, say, 80, 160, 240, 320, etc., feet at mean high water are drawn across the profile. The points of intersection with the forward and after perpendicular are transferred to the body plan center line. The vertical distance between the two points for all the waterlines is divided into the number of equal parts corresponding to the number of stations used. The points so found will give the heights of the waterlines on the various stations for the different distances run.

It may be mentioned that the heights on the perpendiculars for the selected distances of run may be calculated from the known elevations. In this event the profile method serves as a good check, as the correct height of the waterline across *any* station may be scaled from the profile.

Since the boat slides without list, horizontal lines are drawn through these series of points to the proper stations in the forward and after body. It has been found

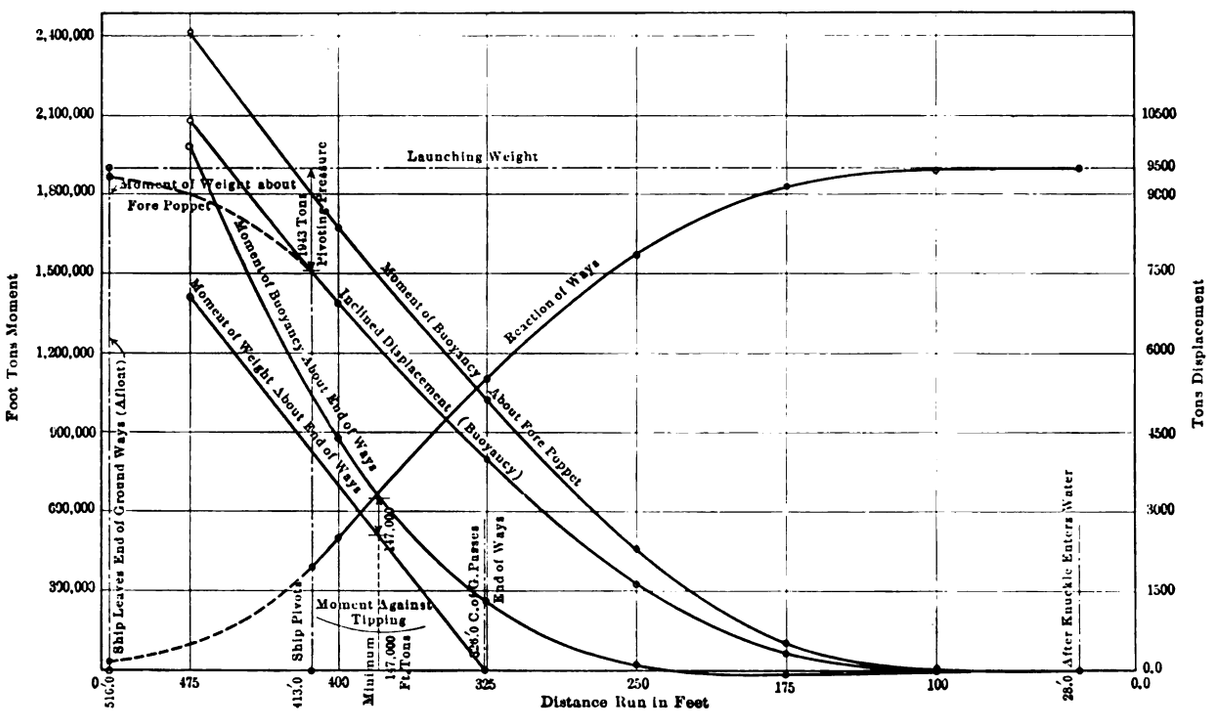

Fig. 5.—Launching Curves

The submerged half sections having thus been drawn for the different runs, the half section areas for all runs are obtained by the careful use of the planimeter. (See Table I.) The functions of areas are put through the rule, trapezoidal is used by the writer as sufficiently accurate, and the inclined displacement and fore and aft position of the center of buoyancy obtained (see Table II) for each of the successive runs.

The values for the early runs are not absolutely necessary, but as they are easily obtained and give additional points for the plotting of the curves, they are usually plotted.

The values for the moments of buoyancy about the fore poppet and about the end of the ways are now worked out and the curves drawn. (See Table III.) These curves should run in smooth and fair. If a point on any curve is "hard" the calculations for this point should be run through and the error found. It will be noted in that a different colored ink used for all lines pertaining to each distance run greatly facilitates this part of the work.

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TABLE I.—TABULATION OF PLANIMETER READINGS, 400 FEET RUN (BROWN).

STATION.	First Reading.	Second Reading.	Difference.	Mean.	STATION.	First Reading.	Second Reading.	Difference.	Mean.
39	(b) 1050 (a) 1000	(c) 1097 (b) 1050	1st 50 2d 47	48	22	4732 3157	7857 6285	1575 1572	1573
38	2032 1867	2195 2032	165 163	164	20	9253 7857	10651 9253	1396 1398	1397
37	2457 2195	2720 2457	262 263	262	18	11858 10651	9405 8200	1207 1205	1206
36	3360 3190	3784 3612	422 424	423	16	9169 8200	10140 9169	969 971	970
34	4524 3784	5268 4524	740 744	742	14	4917 4220	5612 4917	697 695	696
32	6342 5268	7420 6342	1074 1078	1076	12	6034 5612	6458 6034	418 424	421
30	8773 7421	10138 8773	1352 1365	1359	10	6672 6458	6886 6672	214 214	214
28	11693 10138	14812 13258	1555 1554	1555	8	6965 6886	7045 6965	79 80	79
26	16466 14802	3493 1830	1664 1663	1663	6	7055 7045	7063 7055	10 8	9
24	3160 1493	11493 9819	1667 1674	1670	4	....	....	....	0.0

Table I shows a convenient form for keeping the planimeter readings. (*a*) is for the original setting of the planimeter; (*b*) is the reading after having gone around the area bounded by station No. 39 and the 400-foot waterline; (*b*) is then used as the initial reading of the second round and (*c*) is the reading after the second round. The differences can be quickly obtained and likewise the mean reading. This mean reading is the "Function of Area" in Table II. As a rule the last reading on one station may be used as the initial reading on the next station.

TABLE II.—AREA AND BUOYANCY SHEET—400 FOOT RUN (BROWN)

Station No.	Function of Area.	Multiplier.	Multiple of Area.	Lever Arm.	Function of Moments.
4	0	½	0	8	00
6	9	1	9	7	63
8	79	1	79	6	474
10	214	1	214	5	1070
12	421	1	421	4	1684
14	696	1	696	3	2088
16	970	1	970	2	1940
18	1,206	1	1206	1	1206
20	1,397	1	1397	0	Sum = 8525
22	1,573	1	1573	1	1573
24	1,670	1	1670	2	3340
26	1,663	1	1663	3	4389
28	1,555	1	1555	4	6220
30	1,359	1	1359	5	6795
32	1,076	1	1076	6	6456
34	742	1	742	7	5194
36	423	¾	317	8	2536
37	262	½	131	8½	1113
38	164	½	82	9	738
39	48	½	24	9½	228
A. P.	00	¼	00	10	000

15184 Sum = 38,582
−8,525
30,057

$$\text{Constant for Displacement} = \frac{\text{Planimeter factor} \times \text{scale factor} \times \text{distance between stations} \times \text{number of sides}}{\text{Cubic feet per ton (actual)}}$$

$$= \frac{.02 \times 16 \times 25.5 \times 2}{35.439} = .4605$$

Displacement = .4605 × 15184 = 6,992 tons.

$$\text{Center of Buoyancy Aft of Station 20} = \frac{30057 \times 25.5}{15184} = 50.47 \text{ feet.}$$

Fig. 5 that the moment of buoyancy about the end of ways crosses below the base line. This is due, of course, to the buoyancy obtained before the end of the ways is reached. This curve will start at 0 foot-tons, where the ship just enters the water, and will cross the base line, becoming positive at the distance run for which the center of buoyancy is just at the end of the groundways.

The intersection of the curve of moment of buoyancy about the fore poppet and the straight line representing the moment of weight about the fore poppet will, of course, give the point at which the stem will commence to rise, turning about the fore poppet, or, as we say, the vessel will pivot. The difference between the weight and buoyancy at this point is the weight concentrated on the fore poppet, and is called the pivoting pressure. Since this is the maximum pressure on the fore poppet, the pressure varying from this maximum to a minimum when the fore poppet is at the end of the groundways, it is not generally considered necessary to calculate the poppet pressures beyond the pivoting point, although this can be done. The fore poppets being designed for this maximum pressure will, of course, be sufficiently strong for the varying lesser pressures. Therefore the curves of reaction on the ways and actual buoyancy need not be calculated beyond this point, but are drawn in approximately, as shown dotted in Fig. 5, from the two known points—i. e., at pivoting and just when afloat.

The reaction of the ways curve shows in tons the weight which the ways are supporting. This is equivalent

TABLE III.—LAUNCHING CALCULATIONS— SUMMARY OF VALUES FOR CURVES: Slope of keel, 5/8" to foot; slope of warp, 11-16" to foot.

Distance Run in Feet.	Inclined Displacement (Buoyancy)	C. of B. Aft of Midship Section.	C. of B. from End of Ways	Moment of Buoyancy About End of Ways.	Distance from C. of B. to the Fore Poppet.	Moment of Buoyancy About Fore Poppet.	Distance of C. of G. from End of Ways.	Moment of Weight About End of Ways
	(Tons)	(Feet)	(Feet)	(Feet Tons)	(Feet)	Foot Tons)	(Feet)	(Foot Tons)
100	18.6	181.3	—44.7	—831	371.3	6,906	Center of	
175	316.0	125.35	—25.65	—8,105	315.35	99,650	Gravity	
250	1637.0	88.58	12.58	12,593	278.58	456,035	Passes End	
325	3981.0	65.66	64.66	257,411	255.66	1,017,783	of Ways after	000.000
400	699.20	50.47	124.47	870,294	240.47	1,681,366	326' 0"	
475	10437.0	41.63	190.63	1,989,605	231.63	2,417,522	Run	1,415,500

Midship section at Station No. 20, Frame No. 64½. Fore Poppet at Frame No. 17. Total launching weight = 9,500 tons., C. of G. at midship section. Moment of weight About Fore Poppet = 9500 × 190 = 1,805,000 foot tons.

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to the launching weight minus the inclined displacement for any distance run.

The minimum vertical distance between the curves—i. e., the difference in foot-tons value—of moment of buoyancy about the end of the ways and moment of weight about the end of the ways, will be the least moment against tipping. This should be positive and ample to provide against a drop of tide due to unexpected delay in carrying out the launching operations. The value for the anti-tipping moment at low water or any intermediate tide may be ascertained as follows:

Since a drop in tide will make it necessary for the ship to run a greater distance to get the same buoyancy, move the moment of buoyancy about end of ways curve bodily aft a distance in feet $= \frac{\text{drop in tide}}{\text{slope}}$. Then raise all points on the curve an amount in foot-tons equivalent to the gain in moment due to the additional run. Run in the new curve. As before, the vertical distance between this curve and the moment of weight about the end of the ways will be the anti-tipping moment for the new tide.

In another article will be shown a method of obtaining quickly the anti-tipping moment for any tide and for any position of the center of gravity. Such a sheet is of value on the day of the launching, especially when the anti-tipping moment is known to be low.

As may be seen from an inspection of the curves, an increase in moment against tipping may be obtained by increasing the length of the groundways, or by increasing the declivity of the blocks or the ways.

Changing Declivity of Ways

Once the curves are obtained for one declivity of ways, they may be readily obtained for another declivity without repeating the operations outlined above. A greater declivity causes the same buoyancy to be obtained on a shorter run, while a less declivity requires a longer run. Therefore by altering the scale of the distance run in the ratio of the original to the new declivity the buoyancy and moment of buoyancy about the fore poppet may be read from the original curves. Knowing the point of intersection of the old and new ways, the new location of the end of the groundways which gives the desired depth of water over the end of ways is found. The new values of moment of weight and moment of buoyancy about the end of ways are then calculated, and these new curves laid off. Thus a complete set of curves for the new declivity are obtained.

It is well to note that when the launching slip is at all confined the effective height of tide will be lowered, due to water being swept out of the slip by the ship and cradle. The effect on the ship will be as though it was launched on a lower tide, and the results as shown by the curves will not be exactly correct.

Determining Whether the Ship Will Drop When the Fore Poppet Reaches the End of the Groundways

Having drawn the forward end of the ship with the forward end of the fore poppet just at the end of the groundways, ascertain the height of water, w, above the end of groundways at the probable launching tide. Having calculated the probable trim of the vessel, with the forward and after drafts, the draft afloat, d, at the forward end of the fore poppet is determined by proportion.

The distance of the keel above the groundways is fixed, thereby limiting the draft which the forward end of the ship may gain prior to reaching the end of ways. Suppose the draft at the fore poppet on reaching the end of ways is D. If the distance D is $> d$, the ship will be afloat before the fore poppet reaches the end of the ways. If $D = d$, the ship will just float off the ways with no drop. If $D < d$, the ship must drop at this point by at least the amount of the difference $(d - D)$. Of course, if the ship does drop, the distance will be greater than $(d - D)$, due to the accumulated energy.

The matter of drop and the consequent increased momentary draft forward should be investigated, to the end that the channel between the ways may be free of obstructions to such a depth as will insure a safe launching.

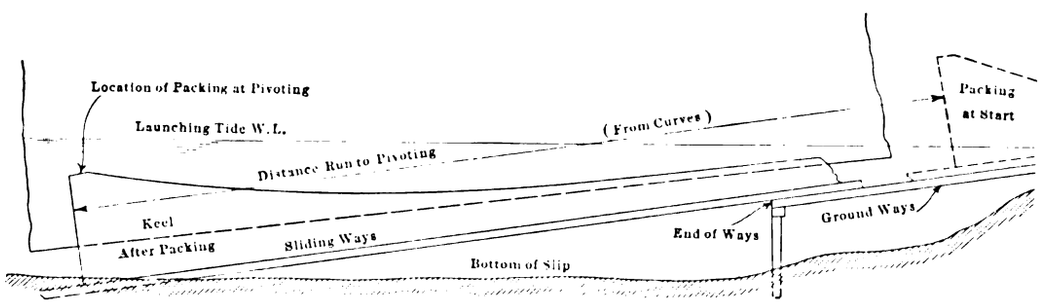

Fig. 6.—Diagram Showing Interference with Bottom of Slip before Pivoting Takes Place

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Salving the Sioux.—One of the most extraordinary mishaps that has occurred in Northern Pacific waters in many years was the recent grounding of the island passenger steamer *Sioux*, during a dense fog, upon the sandy beach of Dungeness Spit in the Strait of Juan de Fuca. Following the mishap tugs were dispatched to pull the *Sioux* off. The combined efforts of three tugs, however, were unavailing, and with each succeeding tide the *Sioux* was carried further up the beach, where the shifting sands held her hard and fast. After several days of unsuccessful effort with a tug, dredgers were obtained which were set to work on either side of the vessel. One dredge was of the clam-shell type and the other a suction machine. After working several days, these dredgers dug a deep channel under the *Sioux* and then she was hauled into deep water. Examination proved that the vessel had been undamaged by her enforced stay of six days on the sandy beach, and she soon returned to service. The *Sioux* is one of the fastest and best equipped passenger vessels on Puget Sound. She was built at Seattle two years ago, and, until the present mishap, has never had an accident of any kind. On anything but a sandy beach this mishap would probably have resulted disastrously. Not every vessel, however, can be "docked on the beach" without damage to her hull.

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New French Battleships

Trials of the Paris and France—Launch of the Gascogne, Normandie and Flandre

Just before the outbreak of the war two powerful battleships of the *Dreadnought* class, the *Paris* and *France,* were delivered to the French Admiralty. The *Paris,* which was built by the Forges et Chantiers de la Mediterranée, at La Seyne, had just completed her full-power trials, while the *France,* which was built by the Chantiers de St. Nazaire (Penhoet), at St. Nazaire, had just returned from a voyage to Russia and Sweden with the President of the Republic on board. Although the *France* had had no time to carry out her full-power trials, nevertheless the return trip from the northern countries, which was made in haste, gave a splendid opportunity to test her seagoing and steaming qualities. For most of the voyage she averaged a speed of 19 knots.

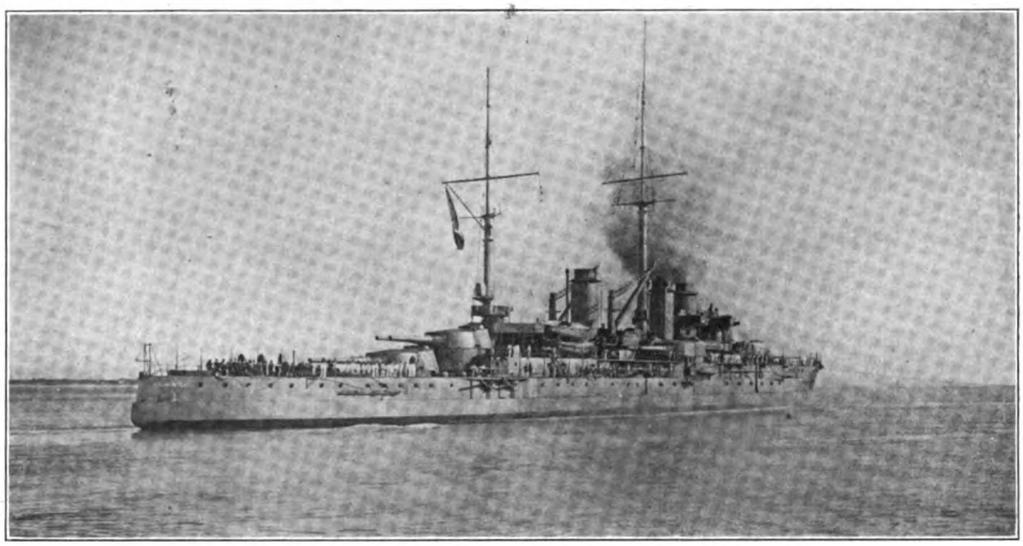

Fig. 1.—Battleship *France*—One of the Latest French Dreadnoughts

The new battleships are 541 feet long between perpendiculars, 81 feet beam and at a draft of 30 feet with the extra bunkers filled and complete stores on board displace 25,850 tons. Propulsion is by Parsons turbines of 25,000 horsepower, designed to give the ships a speed of 20 knots.

On the three-hour full power forced draft trial, the turbines of the *Paris* developed over 35,600 horsepower, giving the ship a speed of 21.7 knots. On a ten-hour run under ordinary draft a speed of 21.15 knots was maintained. The coal consumption on these trials was much less than the contract figures called for, and on account of this the builders received a substantial bonus.

The armament consists of twelve 12-inch guns arranged in six turrets on the centerline of the ship, protected by armor 14 inches thick. There are twenty-two 5.5-inch rapid fire guns mounted in casemates and protected by 7-inch armor. The main armor belt is 12 inches thick, tapering to 7 inches at the ends.

Of the later French battleships, three of the *Normandie* class have already been launched, and while they will not be completed until 1916, they are of special interest because of the new features which have been incorporated in their design.

The Gascogne

The first of this class to be launched was the *Gascogne,* which was launched at the Lorient dockyard September 21, only eleven months after the keel was laid. Her launching weight amounted to 9,500 tons, and, owing to the narrowness of the river in front of the building slip, special arrangements were necessary to bring the vessel to rest after becoming water-borne. Although the vessel moved down the ways at a speed of 20 feet per second, no trouble was experienced in handling the vessel in the narrow river channel.

The *Gascogne* is 574 feet long overall, 88 feet 7 inches beam, and, at a draft of 29 feet with 900 tons of coal on board, she displaces 25,300 tons. Propulsion is by four screws, the wing shafts being driven by triple expansion engines which, at a speed of 115 revolutions per minute, develop 17,500 indicated horsepower (including auxiliaries). The reciprocating engines alone are capable of giving the ship a speed up to 16 knots, but above that the power is augmented by Rateau turbines mounted on the inner shafts. The turbines are capable of developing 16,000 horsepower.

Steam is furnished by twenty-one small-tube boilers of the Guyot-Du Temple patent watertube type, working at 285 pounds pressure. The boilers have a heating surface of 74,000 square feet and are fitted for burning either coal or coal and liquid fuel combined. Nearly all of the auxiliaries are driven by electric power, the electric plant consisting of four turbine-driven generators of 400 kilowatts capacity.

The lines of the hull have been very carefully designed and with a freeboard of 25 feet forward it is expected that the vessel will be able to maintain her speed in a rough sea. Numerous watertight compartments have been worked between the two protective decks, none of these compartments communicating with the bottom of the ship.

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ARMOR AND ARMAMENT

The main armor belt is 15 feet wide, extending 8 feet above the load waterline. The thickness varies from 12 inches amidships to 7 inches at the ends. Above the main armor belt is a central citadel over 370 feet long, protected by 7-inch armor and connected to the turrets amidships by athwartship bulkheads of the same thickness. Above the citadel for a length of 200 feet amidships there is a 6-inch armor protection behind which is mounted the secondary armament.

Special care has been given to the protection of the ship against torpedo attack, and extra longitudinal bulkheads have been worked for nearly the whole length of the ship under the protective deck. These bulkheads consist of three plates, each over ⅜-inch thick, mounted on steel angle bars, the outer plate being offset. This design, while novel, has been proved by experiments carried out at Lorient very efficient as a means for resisting torpedo attack.

The main armament consists of twelve 13-inch guns located in turrets all on the centerline. The turrets are protected by 15-inch armor and each turret is divided into two compartments by an 11-inch armor bulkhead. The forward and after turrets have a range of fire of 280 degrees, while the central turret has a range of fire of 300 degrees. Each turret weighs over 2,000 tons. The secondary armament consists of twenty-four 5.5-inch rapid fire guns and six 18-inch submerged torpedo tubes.

Among other new features which have been worked into the design of the *Gascogne* is the arrangement of the conning tower, which is of large size and divided into three separate compartments, the first and second being devoted to the navigation of the ship and squadron, and the third to the officer in charge of the guns. It is officially stated that the conning tower will be protected by 12-inch armor, but it may be confidently expected that the thickness of the armor will be increased. It is worthy of note that the forward turret wil also contain duplicates of the apparatus in the conning tower, so that it may be used as a secondary conning tower in case of need.

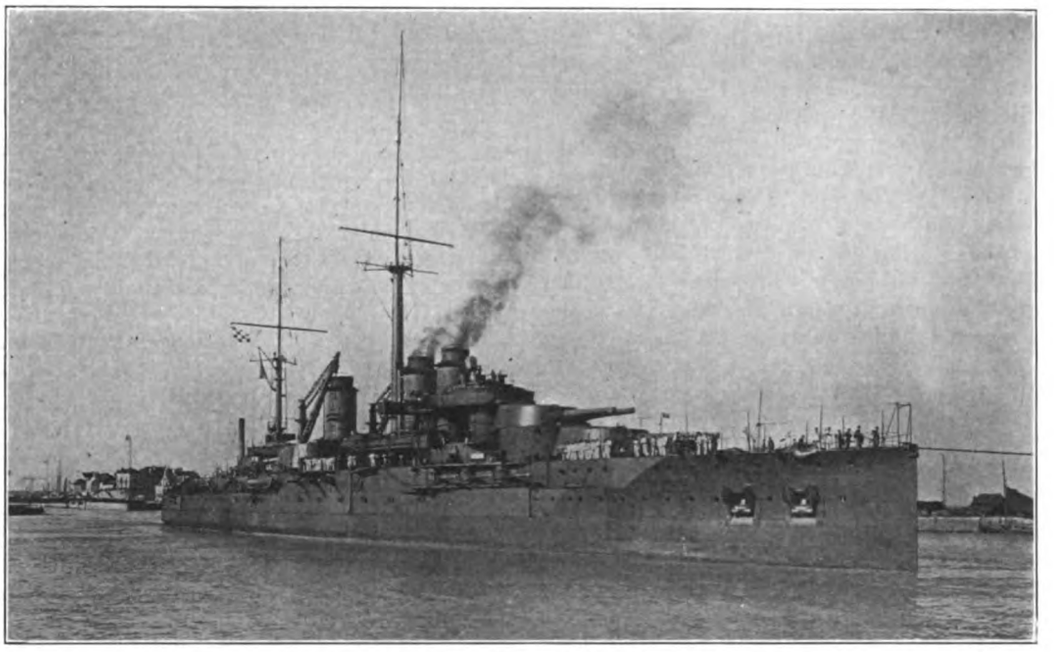

Fig. 2.—Battleship *Paris*, Sister Ship of the *France*

LAUNCH OF THE NORMANDIE

Since the launching of the *Gascogne* two other battleships of the same class, the *Normandie* and *Flandre,* have been launched. The *Normandie* is being built by the Ateliers et Chantiers de la Loire, of St. Nazaire, and the

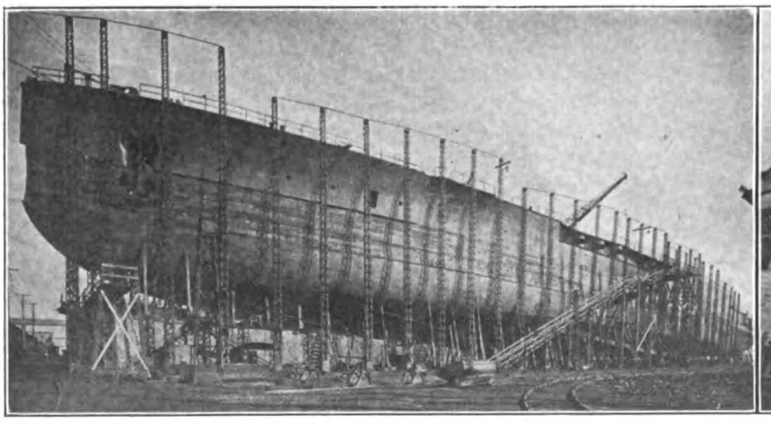

Fig. 3.—The *Normandie* before Launching

Fig. 4.—Stern of the *Normandie*

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Flandre at the Brest dockyard. The keel of the *Normandie* was laid September 10, 1913, and that of the *Flandre* October 9, 1913.

The launching weight of the *Normandie*, including the cradle, was 9,257 tons, representing a pressure of 4.55 tons

Fig. 5.—Forward Turrets of the *France*

per square foot on the sliding ways, which were 519 feet long and 48 inches wide, with a declivity of 6 percent. The vessel went down the ways at a speed of 18 feet per second.

Bids for New United States Destroyers

Bids for the six new torpedo boat destroyers authorized by the last Congress were opened on November 10 at the Navy Department, Washington, D. C. According to the privileges granted under the policy of the Navy Department, two classes of bids were submitted: Class I provided for the construction of hull and machinery in accordance with the Department's plans and specifications, and Class 2 provided for both hull and equipment in accordance with the Department's plans, while the machinery was in accordance with the contractor's plans and specifications.

Seven bids were received, one of which was from the Mare Island Navy Yard, California, and the other six from private yards on the Atlantic and Pacific coasts.

The lowest bid was submitted by the Fore River Shipbuilding Corporation, Quincy, Mass., which offered to build two vessels, Class 2, for $795,000 (£163,000) each, to be completed within from twenty-three to twenty-four months and to have a speed of 29½ knots. The bid submitted by the Fore River Company under Class 1 was $852,000 (£175,000) for each ship.

William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., proposed to build three vessels, Class 1, for $834,000 (£171,000) each, and Class 2 for $825,000 (£169,000) each, to be completed in twenty to twenty-two months and of 29½ knots speed. The Bath Iron Works, Bath, Me., proposed to build two or three vessels, Class 2, for $850,000 (£174,000) each, to be completed in from twenty-three to twenty-four months; speed, 30 knots.

The Union Iron Works, San Francisco, Cal., submitted bids under Class 1 to build each vessel at $880,000 (£180,000). The Newport News Shipbuilding & Dry Dock Company, Newport News. Va., submitted a bid under Class 2 with Parsons turbines to build two vessels of 29½ knots' speed in twenty-three to twenty-four months at $885,000 (£181,500) each, and with Curtis turbines $875,000 (£179,000) each. The Seattle Construction & Dry Dock Company offered to build two boats for $860,000 (£176,000) each.

At the present time the destroyers in question are officially designated Nos. 63-68, inclusive. They are of a type larger than any ship of the destroyer class so far constructed for the United States Navy, and will have a minimum speed of 29½ knots when running under full power conditions. In general features the new destroyers are similar to those recently built, except for increased displacement (1,100 tons as compared with 1,090 tons for the previous class) and the placing of additional torpedo tubes and guns. The armament consists of four sets of 6.8 by 21-inch triple torpedo tubes, two 4-inch rapid fire guns and two 4-inch aero guns, the latter arranged one forward and one aft.

The engine space is divided into two compartments, the forward compartment containing the main propelling machinery and the after compartment the auxiliaries. There are two boiler compartments, each containing two boilers equipped for burning oil fuel only. Each boiler has its own smokestack. The propelling machinery consists of main ahead and astern turbines driving two shafts.

The main particulars of the new destroyers are given below:

Displacement, tons	1,100
Turbine arrangement	twin screw
Shaft horsepower	17,000
Revolutions per minute of main turbines	450
Steam pressure at turbines, pounds gage	250
Cooling surface, condensers, square feet	11,600
Number of boilers	4
Steam pressure at boilers, pounds gage	265
Total heating surface, main boilers, square feet	21,500
Speed, knots	21.5

CUNARD LINER TRANSYLVANIA.—The new Cunard liner *Transylvania*, which recently made her maiden voyage across the Atlantic, marks a step in the adoption of geared turbines for ship propulsion. She is the first large transatlantic liner to be fitted with this type of machinery. The turbines are of the Parsons type, driving twin screws through gear wheels about 10 feet in diameter and 5 feet in breadth. Each shaft is driven by two turbines working in series and operating at about 1,500 revolutions per minute. An astern turbine of the impulse reaction type is incorporated with each low-pressure ahead turbine. The arrangements are such that either the high-pressure turbine or the low-pressure turbine can be used independently, so that any mishap to one turbine will not prevent the vessel from proceeding with both propellers in operation. A complete system of forced lubrication is installed for all turbine and gear wheel bearings. The boiler installation consists of six large double-ended Scotch boilers working under natural draft at a pressure of 210 pounds per square inch. The boilers are arranged in two groups of three each in separate boiler rooms. The vessel is 567 feet long, 66 feet 6 inches beam, 45 feet depth, with a gross tonnage of 14,500 and a displacement of 20,000 tons.

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Repairs to Lake Freighter H. M. Hanna, Jr.

During the disastrous storm on the Great Lakes last November, the freight steamer *Howard M. Hanna, Jr.*, bound from Lorain, Ohio, to Fort William, Ontario, with a cargo of about 9,100 tons of coal, was wrecked on the Port Austin Reef in Lake Huron. Although the vessel was practically broken in two at the after end of No. 7 hatch from the top sides down to the top of the side tanks, which form the hopper bottom of the vessel, and her superstructure and hatches were practically demolished, nevertheless the machinery of the vessel was only slightly damaged. She was salved by the Reid Wrecking Company, of Sarnia, and, after her coal cargo was discharged at Port Huron, patches were put on the cracks on the deck and sides of the ship and she was brought to the Collingwood Shipbuilding Company, Ltd., Collingwood, Ontario, under her own steam for repairs.

As can be seen from the illustrations, the break at the after end of hatch No. 7 was of a very clean character, the fracture passing through the solid shell plating instead of through any of the rows of rivets in either the frames or butts. It is practically certain that the vessel would have broken completely in two if it were not for the hopper construction of the hull, as the fracture extended only from the top sides down to the top of the wing tanks, which form the hopper hold construction.

When the vessel arrived in Collingwood she was placed in the dock for a preliminary examination. It was found that for about 150 feet amidships the bottom was up about 4 feet. Under No. 1 hold the bottom was also up about 1 foot, and just forward of the boiler room a similar state of affairs prevailed. In fact, there were only one or two portions of the entire 480 feet length of the ship that were straight. The vessel was also hogged over 2 feet in the center, and, in order to straighten her out and bring her back to her normal sheer, she was undocked and special cribs were built at the forward and after ends of the vessel, after which she was docked again.

Fig. 2.—After Deck House Demolished

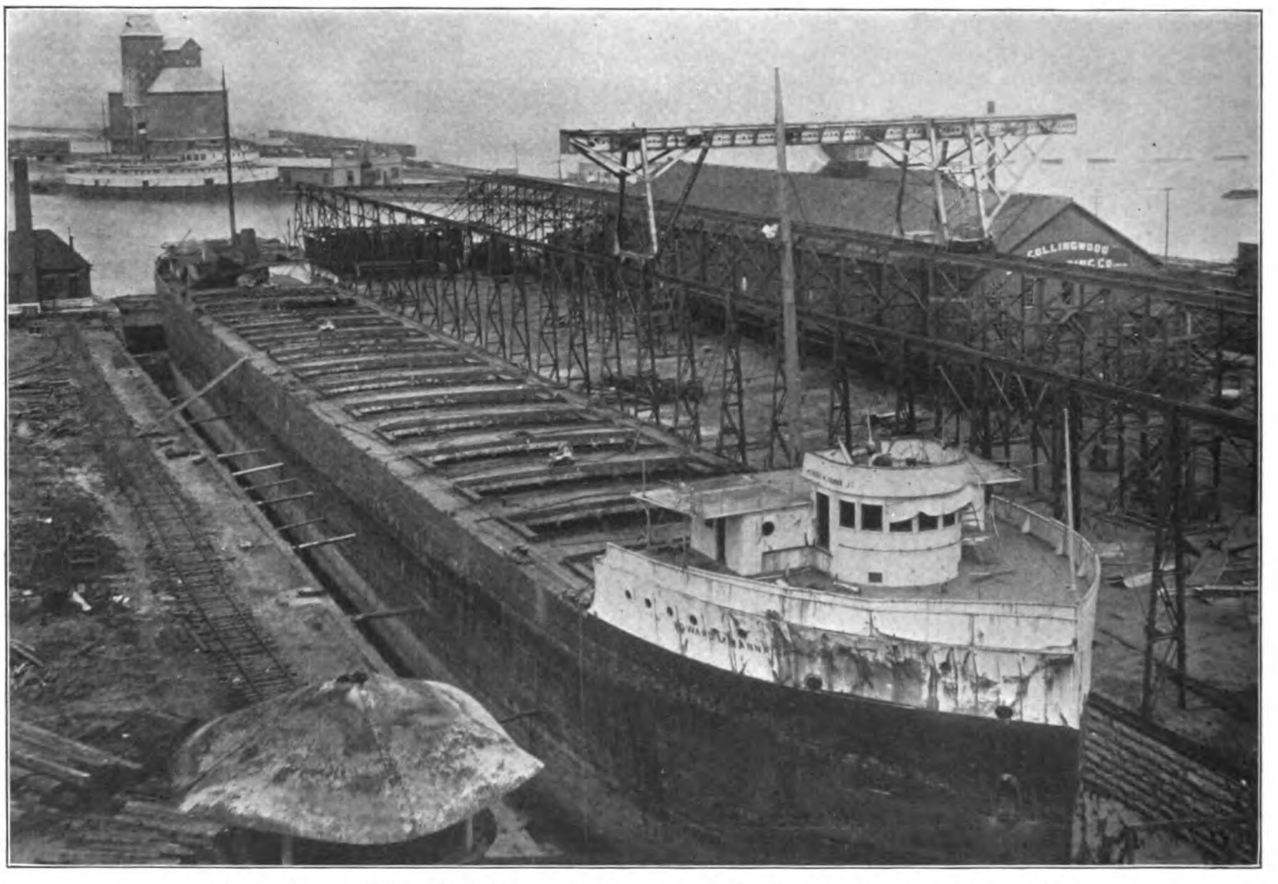

Fig. 1.—Battered Hull of the *Howard M. Hanna, Jr.*, in Dry Dock at Collingwood, August 27

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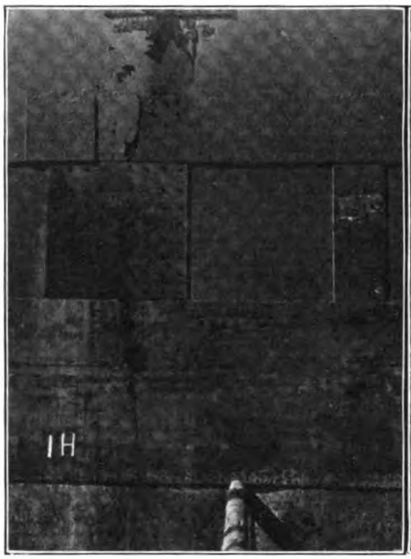

Fig. 3.—Fracture in Shell Plating (Port Side)

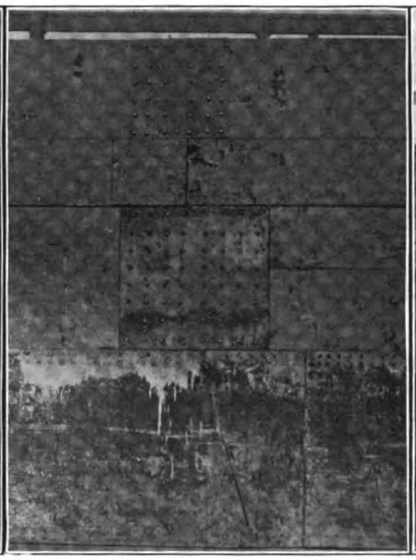

Fig. 4.—Fracture in Shell Plating (Starboard Side)

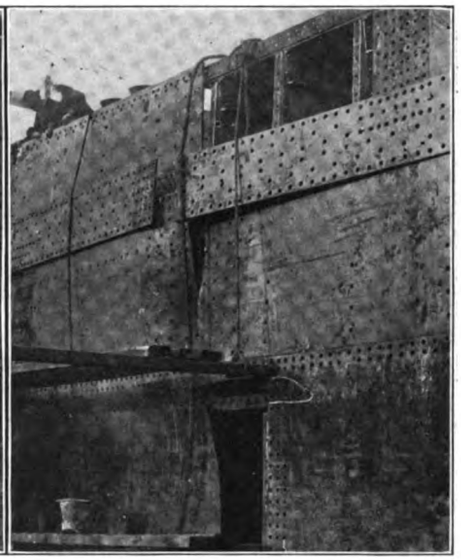

Fig. 5.—Removing the Fractured Plates

Sufficient water was pumped out to settle the vessel on the blocks at the ends, and then work was started cutting out the damaged portions of the shell plating and tank plating, and also the side tanks and stringers. As the cutting proceeded, the water was gradually lowered in the dock, and the vessel allowed to come down. The sheer heights of the spar deck had been obtained from the builders of the ship, and sights were arranged on the deck, so as to tell exactly when the vessel had settled the proper amount. As soon as the normal sheer was reached, the dock pump was stopped and the vessel was securely shored amidships to prevent her from settling any further.

After the dock was pumped out the cutting out of the tank top and bottom plating was begun. Apart from the damage to the bottom, the vessel was very severely punished both before and after going on the rocks. The steel covers over the hatches were badly torn and most of them had been driven into the hold. The 12-inch channel hatch coamings were also badly twisted by the waves coming aboard on the starboard quarter. The forecastle side plating was stove in, as shown in Fig. 1, and considerable damage was done to the pilot house. The after deck house and casing was of very light scantlings, and, together with the smokestack, was easily torn away in the storm, as shown by Fig. 2. Little damage was done to the boilers and propelling machinery, although the propeller itself was damaged by the rocks and the shoe and rudder had carried away.

One of the most remarkable features of the damage

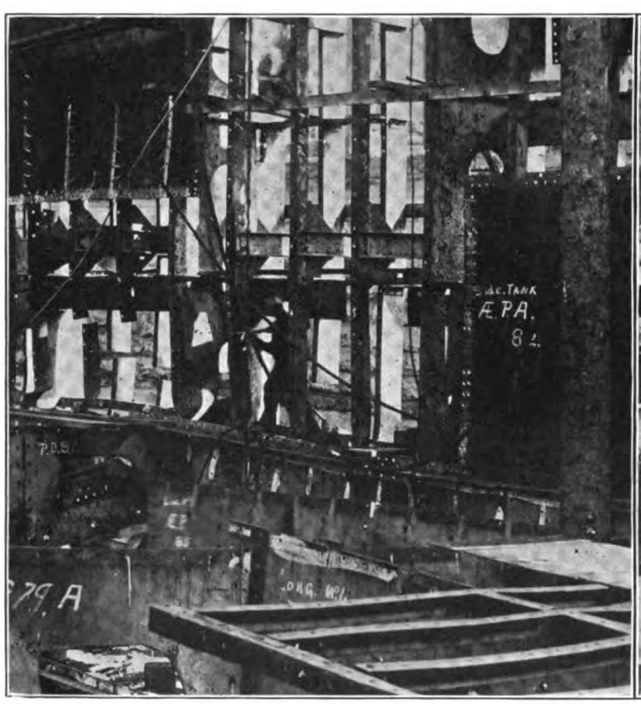

Fig. 6.—Interior View (Port Side)

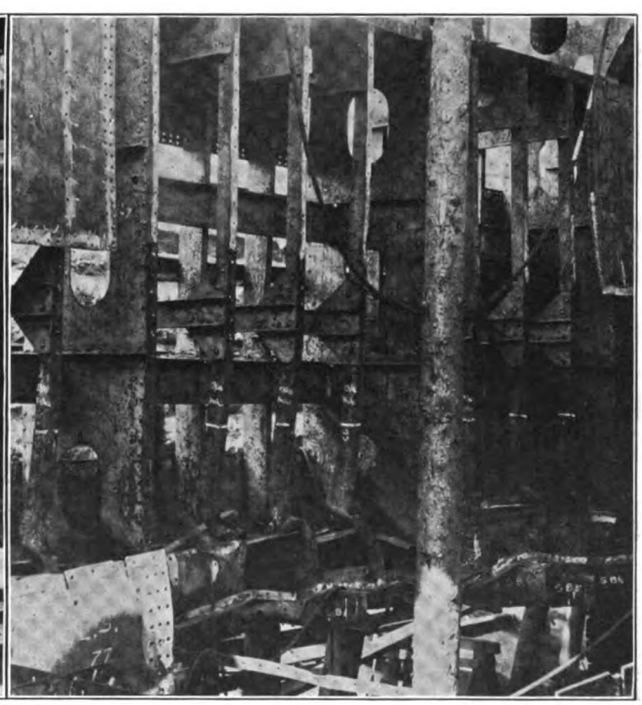

Fig. 7.—Interior View (Starboard Side)

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done to this vessel is the fact that, although the bottom below the tank top, including the floor plates, was twisted out of shape so that the bilge projected out beyond the side of the vessel for a distance of 16 to 18 inches, nevertheless not one of the plates was broken and apparently not a single rivet had sheared or started. This speaks well for the quality of the material and the workmanship in the vessel, and it also shows the strength of the hopper form of construction, for without this the vessel would undoubtedly have been broken completely in two and become a total loss, as was the case with many of the lake vessels in same storm. The unexpected severity of the storm that wrecked the *Howard M. Hanna, Jr.,* however, was something that is very likely to be repeated, and the designers of large lake freighters should bear these conditions in mind.

The White Star Liner Britannic

Main Particulars of the Latest White Star Liner—Details of the Machinery and the Passenger Accommodations

In spite of the war, active construction work continues at the Harland & Wolff shipyard, Belfast, on the 50,000-ton steamship *Britannic,* which the White Star Line expects to place in service in 1915. The vessel was launched February 26, 1914. Her principal dimensions are as follows:

Length overall, about	900 feet
Breadth, extreme, about	94 feet
Depth, molded	64 feet 3 inches
Total height from keel to navigating bridge,	104 feet 6 inches
Gross tonnage, about	50,000 tons
Load draft	34 feet 7 inches
Displacement at load draft, over	53,000 tons
Indicated horsepower of reciprocating engines,	32,000 tons
Shaft horsepower of low-pressure turbine	18,000
Service speed	21 knots
Number of decks	9
Passenger accommodations:	
First class	790
Second class	836
Third class	953
Total passengers	2,579
Crew	950
Total	3,529

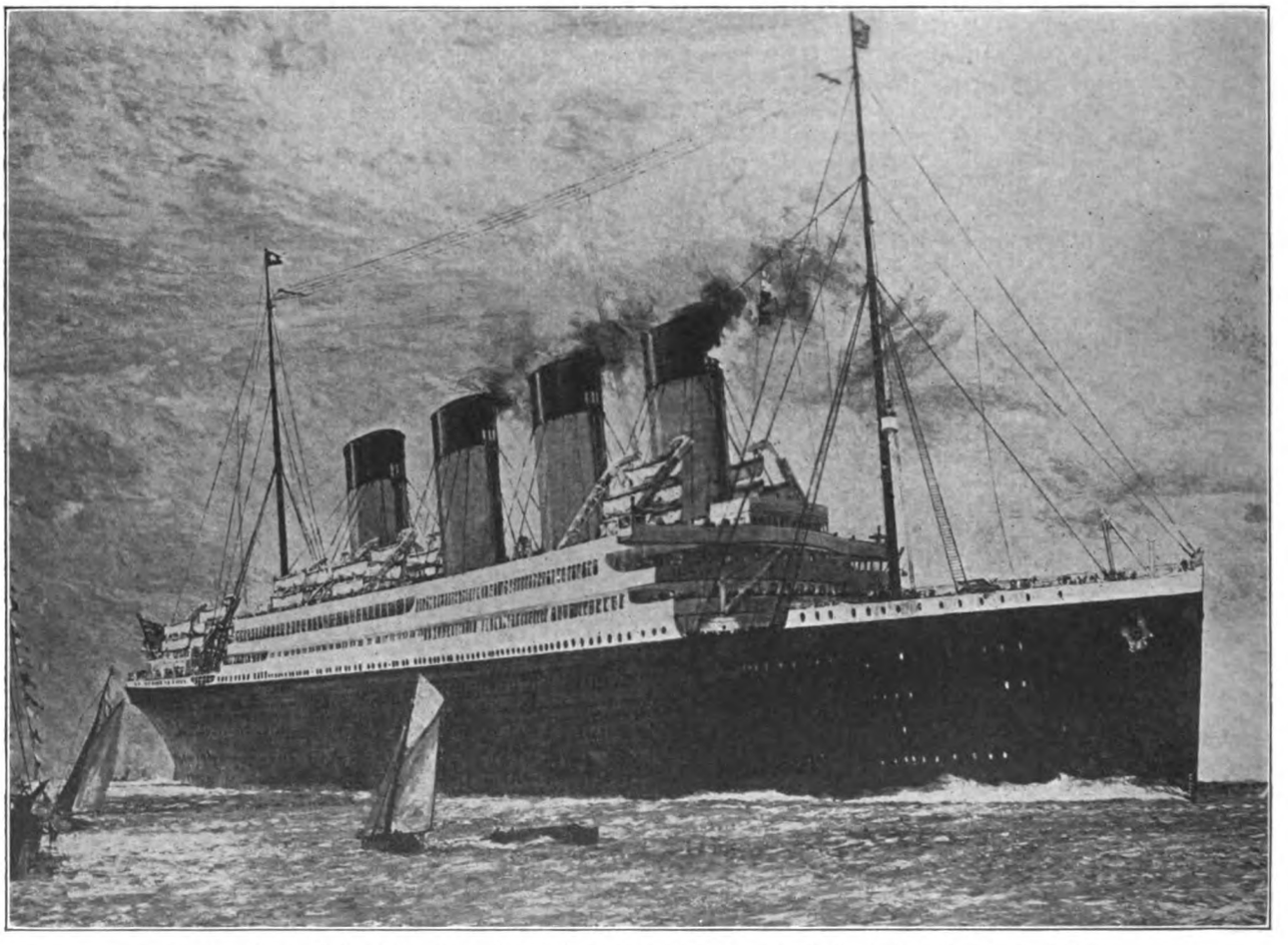

Fig. 1.—Sketch of the *Britannic,* as She Will Appear When Completed, Made from the Builders' Plans

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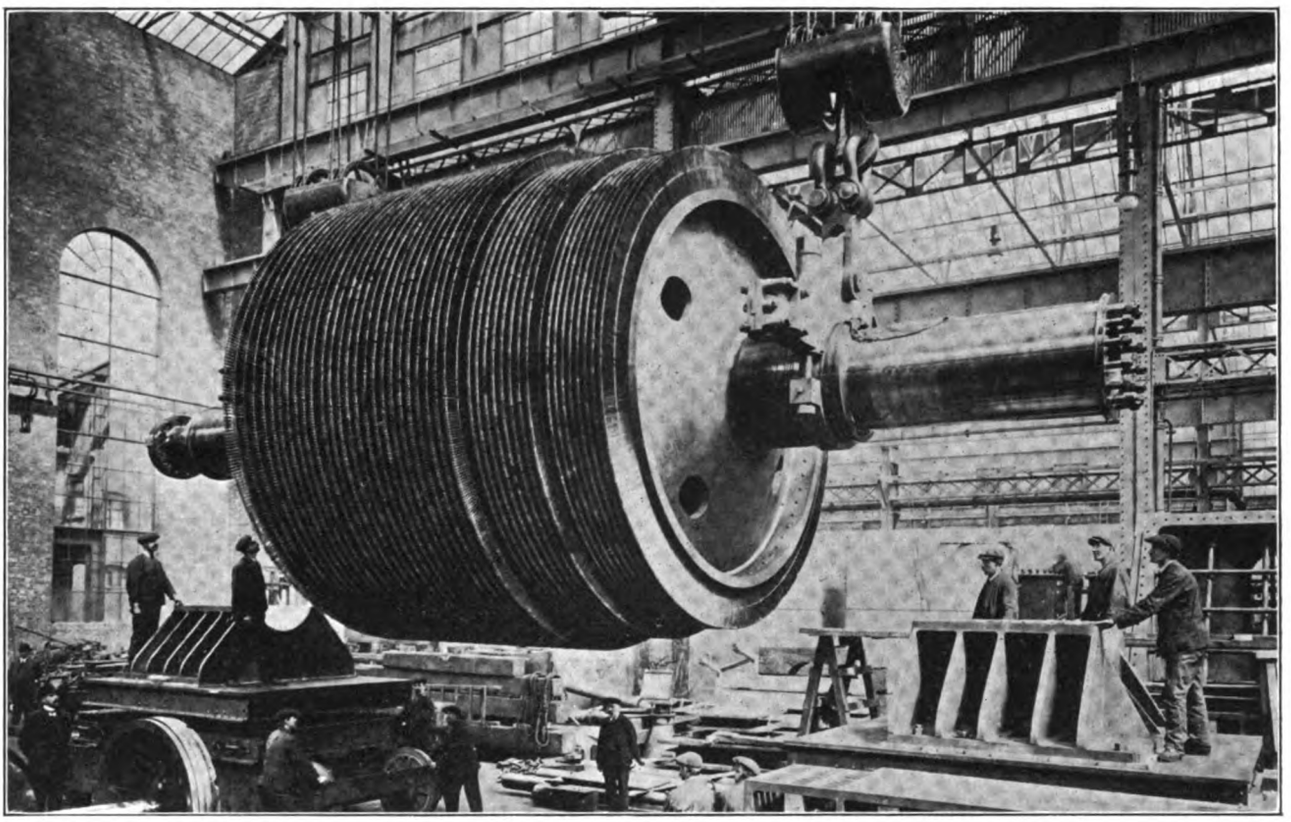

Fig. 2.—Rotor of the Low-Pressure Turbine. Weight, 152 Tons

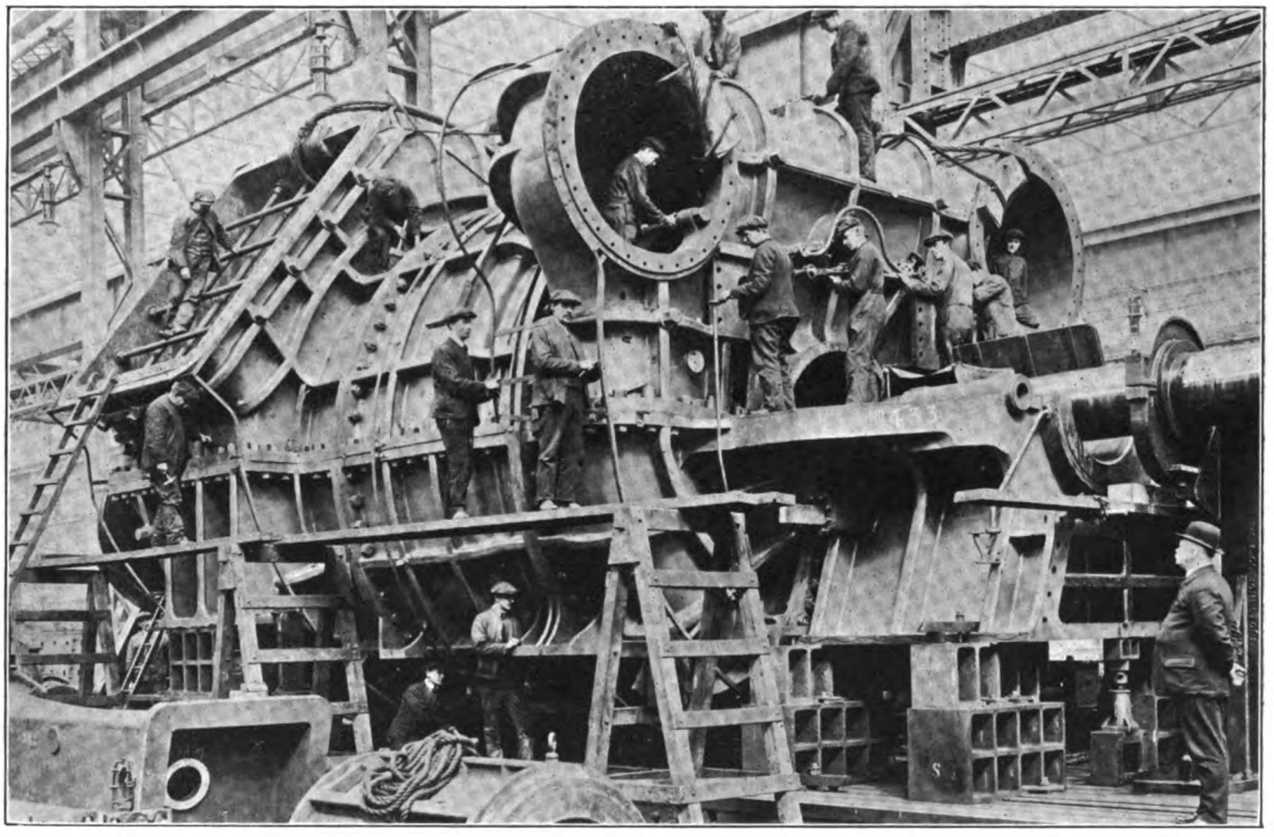

Fig. 3.—Turbine Assembled in the Builders' Shops. Weight about 420 Tons

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The immense size of this new leviathan is better appreciated by reference to the previous ships brought out by the White Star Line during the last fifteen years. In the *Oceanic,* which was completed in 1899, the length was 685 feet and the displacement 31,600 tons at 35 feet 7 inches draft. The *Cedric,* built in 1903, had a length slightly less, but, owing to her greater beam, an increased displacement of 37,900 tons on a draft of 36 feet 8 inches. The *Baltic* of the following year had a length of 708 feet and a displacement of 40,700 tons on a draft of 37 feet 3 inches. The *Adriatic,* completed in 1906, was the next notable ship, and in her case the length was over 725 feet and the displacement 40,800 tons. The *Olympic,* completed in 1911, marked a still further increase in length to 882 feet 9 inches with a displacement of 50,000 tons on 34 feet 6 inches draft. Compared with the foregoing, the *Britannic,* with slightly increased beam resulting in a displacement of over 53,000 tons on a draft of 34 feet 7 inches, marks a logical advance in size of the White Star ships thoroughly in keeping with the policy of the company, which has been closely adhered to ever since the White Star Line became one of the foremost transatlantic steamship companies.

Special interest in the construction of the *Britannic,* however, centers in the machinery. Propulsion is by three screws, the wing screws being actuated by four cylinder triple expansion engines with cylinders 54, 84, 97 and 97 inches diameter and 75 inches stroke located in one engine room with the usual feed, sanitary and bilge pumps and all auxiliaries associated with the boiler feed and the refrigerating machinery in the same compartment. The center screw is driven by a low-pressure Parsons turbine about 50 feet long, which weighs complete 490 tons and operates at full power at 170 revolutions per

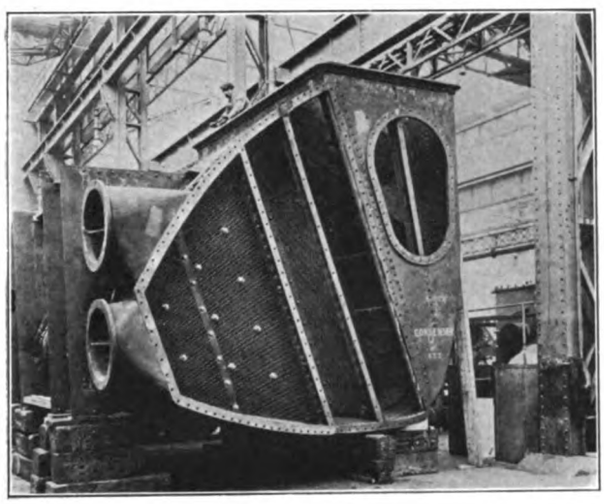

Fig. 4.—Condenser

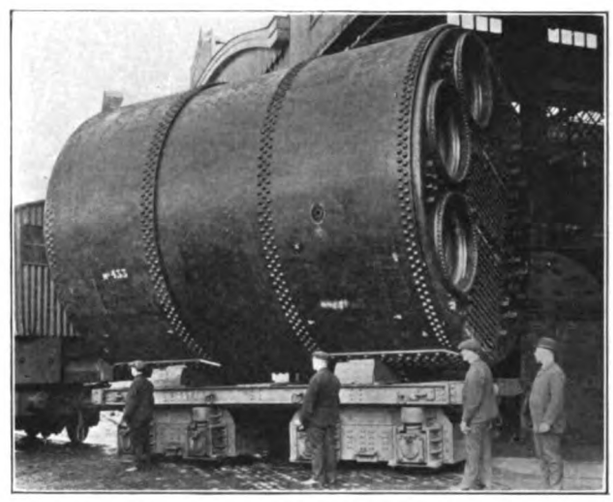

Fig. 7.—One of the Double-Ended Boilers

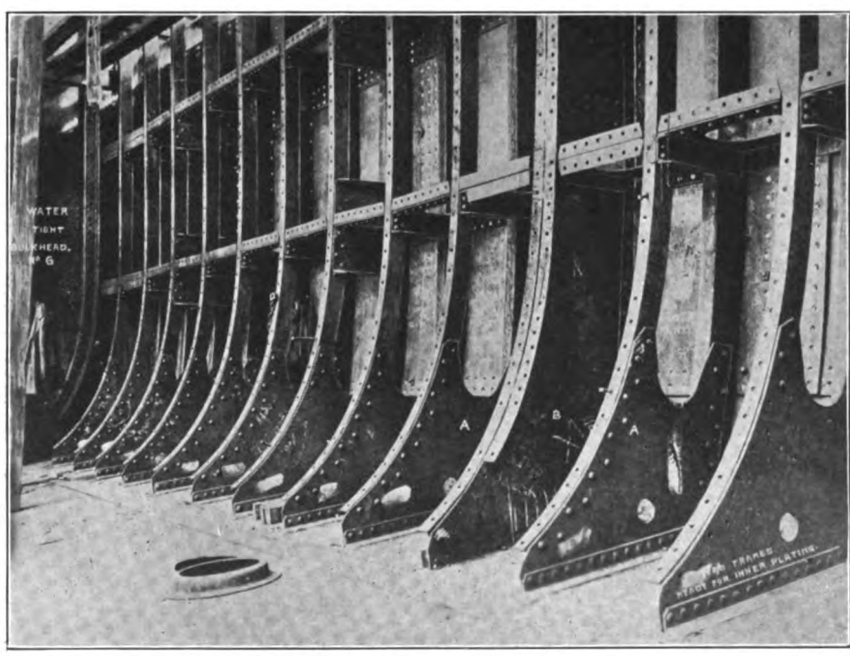

Fig. 5.—Framing for Inner Shell

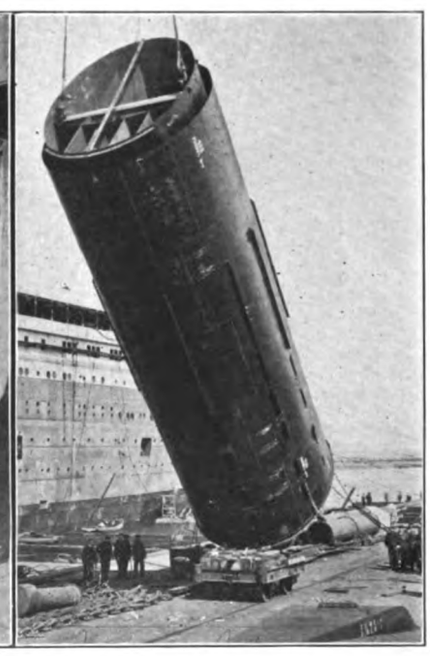

Fig. 6.—Smokestack

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minute, taking exhaust steam from the reciprocating engines at about 9 pounds pressure absolute and exhausting into two condensers at about 1 pound absolute. When running at 165 revolutions per minute, the turbine will develop more than 16,000 horsepower. The turbine is used only for ahead propulsion, the backing and maneuvering being taken care of by the reciprocating engines.

Fig. 2 shows the rotor of the turbine, which, apart from the casing, weighs 152 tons. Its exact dimensions are: Length, 49 feet, and diameter 16 feet 11 inches. It is among the largest and most powerful ever constructed for marine service. The blading is of the regular Parsons laced type, with the distance pieces at the roots and binding soldered on the edge. The blades range in length from 18 inches to 25½ inches. Fig. 3 shows the complete turbine with casing assembled. Its weight is about 420 tons.

Steam is supplied by twenty-four double-ended and five single-ended boilers arranged in six boiler rooms. The boilers are all 15 feet 9 inches mean diameter. The double-ended boilers are 21 feet mean length and the single-ended boilers 11 feet 9 inches mean length. The heating surface of each double-ended boiler is 5,702 square feet and the grate area 130.8 square feet, while in the single-ended boilers the heating surface of each is 2,822 square feet and the grate area 65.4 square feet.

There are in all four funnels of elliptical section with a major diameter of 24 feet 6 inches and a minor diameter of 19 feet 10 inches. The total height of the funnels above the grates is 150 feet. About twenty uptake branches lead to each funnel.

On six of the nine decks in the ship accommodations are provided for about 2,600 passengers. The first class accommodations are amidships and the second class immediately abaft the first class quarters. On the bridge deck, the first deck immediately below the boat deck, are a large gymnasium, a children's play-room and an à la carte restaurant extending the full width of the ship. On the promenade deck immediately below are the public rooms, including a reading and writing room, a first class lounge and a first class smoking room with veranda café and palm court. The shelter deck is given over almost entirely to first class staterooms, while on the deck below is the main dining-room and a reception room in connection with it. Three electric elevators extend through the first class quarters clear up to the boat deck, while further aft is another first class elevator extending up to the boat deck.

In the second class accommodations, the dining saloon is on the saloon deck, the library, reading room and second class gymnasium on the shelter deck, while the smoking room is on the bridge deck with a large space for promenade. The third class public rooms are in the stern of the ship with the exception of the dining saloon, which occupies a space of two watertight compartments on a lower deck amidships.

The sanitary arrangements, heating and ventilating systems and the electric plant embody the latest features which have been developed for marine work. The life-saving apparatus includes forty-eight of the largest size lifeboats yet made, two of which are fitted with motors for propulsion.

An entirely new type of davit is used for handling the boats. There are two sets of davits on each side of the boat deck, of lattice girder construction pivoted at their ends and actuated from a vertical position to a considerable angle either inboard or outboard by means of an electric motor-driven screw gear. The height and outreach of the davits enable the boats to be mounted one over the other in tiers and also facilitate the placing of several tiers in the width of the ship. This type of davit permits stowing the lifeboats a sufficient distance inboard to give a wide passage along the deck for promenading and for grouping the passengers in case of emergency. Special devices are fitted to arrest the motion of the davits or boats in case of a mistake on the part of the operator, and powerful electric lamps are provided at the top of each davit to facilitate the operation of the gear at night. Means are also provided for lowering the boats on an even keel, irrespective of the trim of the vessel.

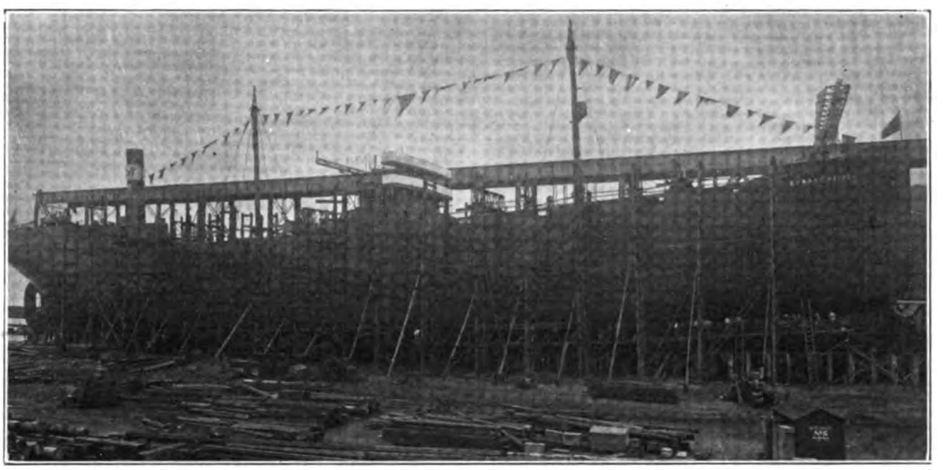

Fig 1.—Steam Collier *Edward Peirce* before Launching at Newport News

Steamship Edward Peirce

The sailing of the steamship *Edward Peirce* from the yard of her builders, the Newport News Shipbuilding & Dry Dock Company, adds another "made in America" unit to the not overcrowded merchant marine of the United States. This is the third steamer for the Crowell & Thurlow Steamship Company, of Boston, Mass., built at Newport News, as the *Peter H. Crowell* and *Lewis K. Thurlow* are the products of the same yard.

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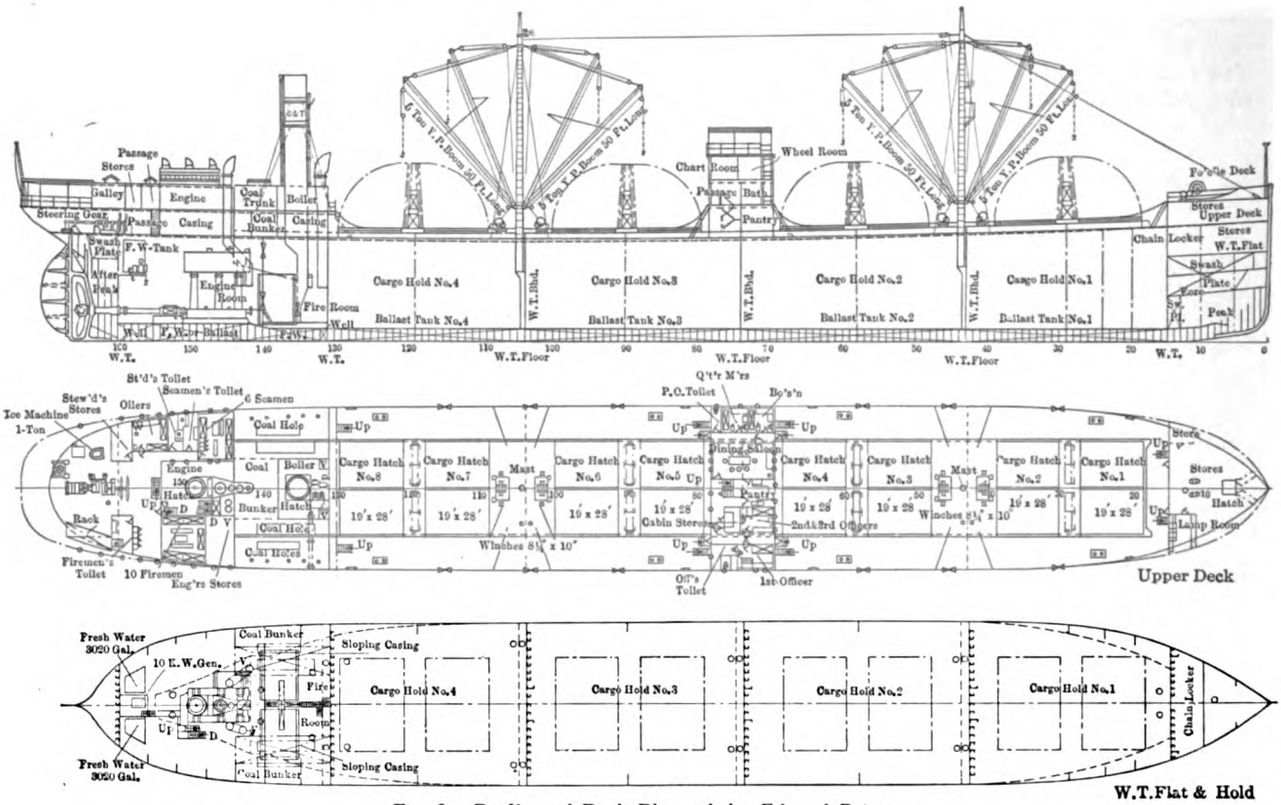

Fig. 2.—Profile and Deck Plans of the *Edward Peirce*

The *Edward Peirce*, while designed primarily for a collier, is fitted with cargo handling gear, cargo battens, etc., so that her usefulness is not confined to carrying coal. The vessel will make a successful carrier for any kind of bulk cargo, lumber or general cargo.

The dimensions are as follows: Length overall, 375 feet; length Lloyds', 360 feet; beam, molded, 49 feet; depth, molded, 30 feet; deadweight at 23 feet draft, 6,500 tons; sea speed, loaded, 10 knots; gross tonnage, 4,387; net tonnage, 3,228.

The vessel is a single screw steamer with two masts and machinery aft. The accommodations for the deck officers are in a short bridge amidships. The crew and engineers are accommodated under the poop deck and in a deck house on the poop deck. The galley, refrigerating rooms and refrigerating machinery are aft, and there is a direct connected steam steering gear, with telemotor control from the pilot house. A continuous trunk for the extent of the hatch openings permits the decks to be raised between hatches, simplifying drainage and gaining in cubic capacity. There are eight hatches 19 feet by 28 feet, fitted with steel hatch covers and rubber gaskets.

The propelling machinery consists of a triple expansion engine with cylinders 23 inches by 39 inches by 66 inches diameter by 45-inch stroke, a main and auxiliary condenser, an air pump of the Edwards type, a centrifugal circulating pump, two attached feed pumps, two attached bilge pumps, a fire and donkey pump, ballast pump, one 20-ton evaporator, a Reilly feed water heater and Ebson filter. The boilers are of the single-ended Scotch type, 15 feet diameter, 11 feet 6 inches long, with three 45-inch Morison furnaces and separate combustion chambers. They are designed for heated forced draft, and a working pressure of 180 pounds of steam.

The keel of this vessel was laid June 17, and the vessel was launched October 24, with engines aboard, stack up, boilers tested and ready for steam. The dock trial was held on November 2, and the vessel was delivered to its owners on November 6, 1914. The general arrangement of the vessel is illustrated in the accompanying plans.

Progress of U. S. Naval Vessels

The Bureau of Construction and Repair, Navy Department, reports the following percentage of completion of vessels for the United States navy:

BATTLESHIPS

	Tons.	Knots.		Aug. 1.	Nov. 1.
Nevada	28,000	20½	Fore River Shipbuilding Co..	72.4	77.8
Oklahoma ...	28,000	20½	New York Shipbuilding Co..	72.6	79.3
Pennsylvania.	31,400	21	Newport News Shipbuilding..	42.0	58.3
Arizona	31,400	21	Navy Yard, New York.....	24.4	36.8

TORPEDO BOAT DESTROYERS

Downes	1,010	29	New York Shipbuilding Co...	95.3	95.3
O'Brien	1,050	29	Wm. Cramp & Sons.....	79.0	88.4
Nicholson ..	1,050	29	Wm. Cramp & Sons.....	73.3	86.5
Winslow	1,050	29	Wm. Cramp & Sons.....	71.5	82.3
Cushing	1,050	29	Fore River Shipbuilding Co..	56.1	73.7
Ericsson	1,050	29	New York Shipbuilding Co...	76.9	87.4
Tucker	1,090	29½	Fore River Shipbuilding Co..	12.6	18.8
Conyngham..	1,090	29½	Wm. Cramp & Sons.....	11.1	39.5
Porter	1,090	29½	Wm. Cramp & Sons.....	9.0	29.5
Wadsworth..	1,090	29½	Bath Iron Works.....	48.4	66.4
Jacob Jones.	1,090	29½	New York Shipbuilding Co...	14.9	33.7
Wainwright..	1,090	29½	New York Shipbuilding Co...	14.4	33.4

SUBMARINE TORPEDO BOATS

G-4	....	....	Wm. Cramp & Sons.....	96.4	100.0
G-2	....	....	Newport News Shipb'g Co...	89.7	89.7
G-3	....	....	Lake T. B. Co.....	82.3	85.7
K-3	....	....	Union Iron Works.....	98.1	100.0
K-4	....	....	Seattle Con. & D. D. Co.....	98.8	100.0
K-5	....	....	Fore River Shipbuilding Co..	98.8	100.0
K-6	....	....	Fore River Shipbuilding Co..	98.8	100.0
K-7	....	....	Union Iron Works.....	94.3	98.1
K-8	....	....	Union Iron Works.....	94.3	98.1
L-1	....	....	Fore River Shipbuilding Co..	49.3	67.4
L-2	....	....	Fore River Shipbuilding Co..	48.2	66.2
L-3	....	....	Fore River Shipbuilding Co..	47.3	66.1
L-4	....	....	Fore River Shipbuilding Co..	46.6	65.7
L-5	....	....	Lake T. B. Co.....	28.9	41.2
L-6	....	....	Lake T. B. Co. (Long Beach, Cal.)	28.1	41.7
L-7	....	....	Lake T. B. Co. (Long Beach, Cal.)	26.6	39.7
M-1	....	....	Fore River Shipbuilding Co..	33.1	50.6
L-8	....	....	Navy Yard, P'tsmouth, N. H.	0.0	0.0
L-9	....	....	Fore River Shipbuilding Co..	12.3	24.9
L-10	....	....	Fore River Shipbuildiing Co..	12.3	23.8
L-11	....	....	Fore River Shipbuilding Co..	11.2	0.0

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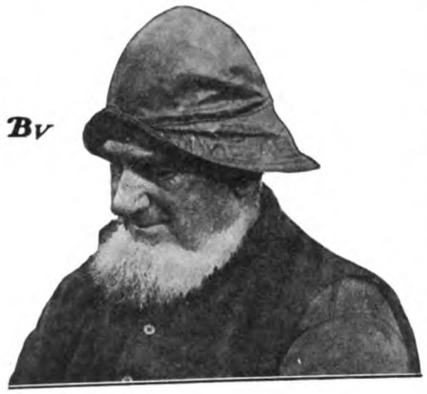
Economy Talks By "Old Scotch"



Clean Boilers and Tight Joints Another Source of Economy

Well boys, we must continue our chase for that saving I have been telling you about. Of course, the greatest saving, as I said before, is in burning the fuel properly, but we can save a whole lot by being clean.

By that I don't mean that any of you need a bath, for I would be the first one to be insulted if any one insinuated that marine engineers didn't bathe often enough. If I do say it myself, we are the cleanest people on earth, personally—but some of us are not so clean when we come to the iron workmen that we run and look after. A man may go around dirty and lose nothing but his self-respect, but if we let our boilers go dirty we are losing coal—and coal is money. Some old philosopher said that cleanliness is next to godliness, and that's the reason washday comes on Monday. So it is with us marine engineers, the next most important thing to saying our prayers is to keep our boilers clean.

I mean just what I say about "keeping them clean." That doesn't mean altogether that we should clean them after they get good and dirty, but that we should start in with them clean, and try to "keep them clean." The main business of a marine boiler is to transmit the heat from the furnaces and tubes through the metal into the water and turn it into steam. Steel and iron, with clean surfaces, just dote on passing heat units right on through from the fire-side to the water-side. If, on the water-side, we allow scale and dirt to collect, then there is a strike in the transmitting apparatus right off. For every 1/16 of an inch of scale or dirt formed on the water-side of the heating surfaces, it is "good-night" to about 10 percent of your heat transmission. If you're burning fifty tons of coal a day under ordinary circumstances to make the required speed, then when this scale gets busy blocking the heat units, you may just as well prepare to burn up fifty-five tons of coal per day to accomplish the same work. It's all right to put non-conducting material on the outside of the boiler, but don't ever let it get on the inside. I've seen some old boilers so badly scaled up that I really believe they would have worked better if they had been turned inside out.

It's just about as bad for economy if you allow the soot to collect on the fire surfaces of your flues and tubes. Soot isn't much better as a conductor or transmitter of heat units than boiler scale, so you can see that it is a case of the Lord help any poor boiler which suffers from both scale and soot, and I want to tell you right here that there are plenty of boilers running right now which have both afflictions. You might just as well try to get a good day's work out of a laborer who is suffering from stomach-ache and rheumatism at one and the same time.

The stomach-ache and boiler-scale are something alike, as they both can be cured by a liberal use of good, old-fashioned soda. I can't say that there is any similar remedy for both soot and rheumatism. Soot can be gotten rid of with brushes and elbow-grease, but I haven't heard of anything yet that will take this rheumatism out of my right shoulder, when it gets to going good and strong.

There are other things around a fireroom which cause waste besides scale and soot. They say that money is the root of all evil, and procrastination is the thief of time. I'm not sure about the money proposition, but I do know that procrastination, or "putting off," whichever label you choose to put on it, is somewhat of a thief of heat units, when it comes to pulling off the stopping of leaks around a boiler or the making of new joints in the steam pipes, and boiler connections. If I go into a fireroom and hear a lot of hissing like a den of sarpints, I always think of the good money that is being wasted, and of how lazy the chief engineer must be to let steam or hot water escape that way. A half dozens leaks around a fireroom which make noise enough to be heard plainly are about equal to the waste of a ton of coal a day on an average-sized steamer. The only noises that ought to be heard around a well-managed fireroom are the sounds of the shovel, the roar of the draft and the lullaby of the water tender as he jumps on a fireman for keeping the furnace-doors open too long.

Of course, every leak in a steam joint is not due to laziness, as many of them come from using bum packing, where only the best material should have been used. If the engineer is supplied with cheap packing, that is, the kind composed of 2 percent rubber, 4 percent fiber and 94 percent of baked mud, he can't be expected to keep steam joints tight. The company saves a dollar and a half in gaskets and loses a couple of hundred dollars in coal by buying that kind of material.

While I am strong for economy in every legitimate way, it has been my experience for many years' standing—or, I might say, running—that you never save anything around marine machinery by using cheap materials. The best is none too good on board steamships. When you are out at sea, you're a long ways from a safe place, and the lives of all on board, as well as the ship and cargo, depend upon everything around the machinery ringing true. It's no place for bad coal, bad oil, bad packing, bad tools, or, in fact, for anything which only has cheapness to recommend it. Whenever a man tries to sell me anything for use on my job and dwells stronger on its cheapness than on its good quality, he not only doesn't make any sales, but he is told to go where there is plenty of heat, but no steam pipes to leak.

Yours for economy,

Old Scotch

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Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding will be Answered in this Department

CONDUCTED BY H. A. EVERETT *

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so. Indicator cards taken from marine engines will be carefully analyzed, the defects pointed out, and the horsepower calculated, provided complete data are sent with the cards.

Q.—How thick should the fires be kept for good combustion and economical operation? S. M.

A.—For good non-caking coal and natural draft about 6 inches, for caking coal about 8 inches, and for forced draft sometimes as thick as 12 inches are good practice.

Q.—Which is the correct way to run oil grooves in the crosshead, crank and main bearing brasses of a marine engine to secure best results? C. M. C.

A.—Oilways should be cut so that the oil is brought to the point of greatest pressure, and also is forced to distribute itself evenly over the face of the bearing, but they should not be cut so that the oil tends to run out at the end of the journal. The figure-of-eight groove is generally the most satisfactory for small bearings. Oilways should not be cut in line with the greatest stress in a bearing, as they then weaken the white metal at the point where it most needs strength.

Q.—Please give a formula for the calculation of flat surfaces. First, for the shell of an oval condenser; second, for flat valve chest covers. Will you also kindly give the width at the outer and inner rims of an impeller 28 inches diameter, number of revolutions 410; suction diameter, 16 inches; circulating pump to deliver 7,500 gallons of water per minute; head of water, 15 feet. L. S.

A.—The theory of elasticity gives us a method of *readily* calculating *two* sorts of flat surfaces subjected to uniform pressure and by involved and complex calculations the solution of several others. The two cases which permit of ready solutions are:

First, flat circular plates either supported or fixed at the edges (Figs. 1 and 2), and second, flat plates supported at regular intervals by stays as the sides of a locomotive firebox (Fig. 3).

For circular plates

$$t = r\sqrt{\frac{5p}{6f}}$$ when supported at edges.

$$t = r\sqrt{\frac{2p}{3f}}$$ when fixed at edges.

t = thickness in inches.
r = radius of plate in inches.
p = pressure pounds per square inch.
f = fiber stress per square inch.

If an allowable working strength be used of 2,500 pounds for cast iron, 6,000 pounds for wrought iron, and 10,000 for steel, the above formulæ become

	Supported	*Fixed*
Cast iron.....	$t = .0183\ r\sqrt{p}$	$t = .0163\ r\sqrt{p}$
Wrought iron.....	$t = .0118\ r\sqrt{p}$	$t = .0105\ r\sqrt{p}$
Steel	$t = .0091\ r\sqrt{p}$	$t = .0082\ r\sqrt{p}$

For a flat plate supported at regular intervals the working stress (f) is given by $f = \frac{2a^2}{9t^2}p$, in which a is the pitch in inches of the supporting elements and the other letters have the same significance as already given. The deflection of the plate (v) in inches is given by $v = \frac{p a^4}{36 E t^3}$ where E is the modulus of elasticity, fair values of which are

17,000,000 for cast iron.
28,000,000 for wrought iron.
30,000,000 for steel.

In one form or another the above formulæ serve for most

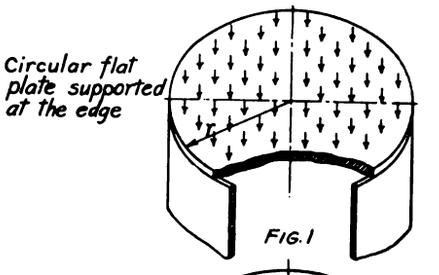

FIG. 1

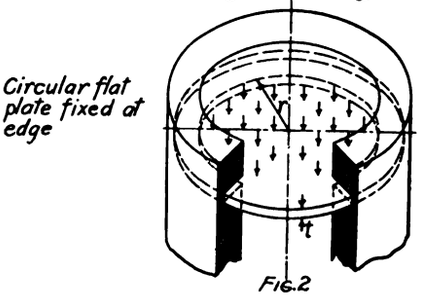

FIG. 2

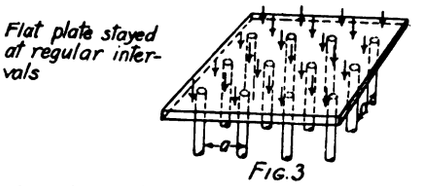

FIG. 3

of the engineering calculations involving the design of flat surfaces intended to withstand pressure. There is no simple calculation for the shell of an oval vessel.

The width at the outer rim of the impeller blades for the pump given would probably be about 4 inches and for the inner rim 8 inches. The pump has a suction diameter which is considerably larger than is common, but there may be some reason for this which is not stated.

Q.—Will you please explain how the hull of an electric lighted steel ship becomes seriously pitted below the waterline? Also is there any way to determine if this action is going on while the ship is in service? Also what step should be taken to prevent this trouble? SUBSCRIBER.

A.—The responsibility for severe local corrosion or pitting of a vessel's shell below the waterline has frequently been attributed to electrical installations of one sort or another. When the single wire system of lighting is used the hull serves as the return conductor and it is possible that in the large electrical installations the return current along the hull structure may be of sufficient intensity to cause slight corrosion at the butts in the plates.

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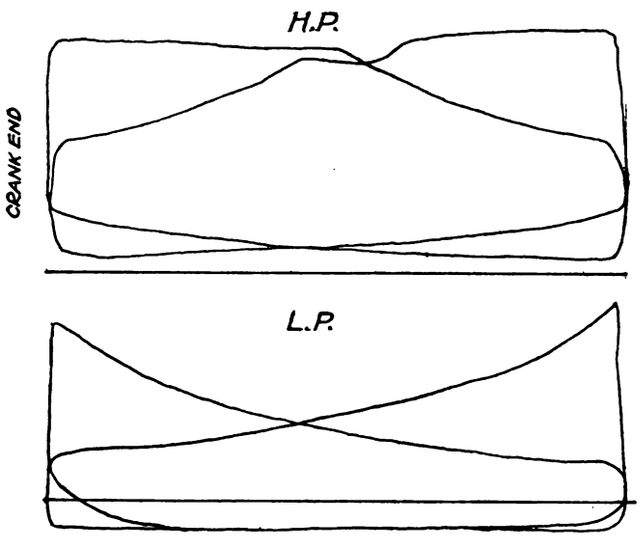
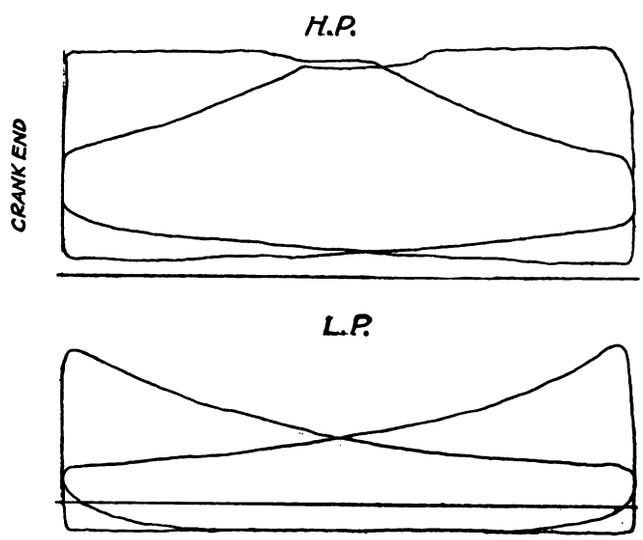
But the area of the shell is so large and the return current so feeble that under any case generally met with it is quite negligible. With the two-wire system which is now principally used the hull carries no current.

The consensus of opinion of recent years has been that the responsibility for deterioration of this sort comes from some source other than the electric light plant, frequently from local galvanic action as between the steel hull and bronze propeller, pump, or other attachment, and sometimes from acid in polluted water, as may be found when moored near a sewer discharge or the discharge of water from some industrial plants, as gas works. Either of these latter causes will produce rapid and destructive pitting or corrosion. Galvanic action can be rendered harmless by the use of zinc plates attached to the steel hull near the element which forms the other pole. The other can be retarded by frequent painting and cured by removal to clear water. An easy test for acidity is by litmus paper, but if corrosion is pronounced a chemical analysis is better. Occasionally if the insulation is defective there may be an electric leakage sufficient to cause local corrosion, but this is easily stopped by repairing the insulation, which should not have been allowed to reach such a state.





Q.—Please give a complete analysis of the indicator cards shown herewith, which were taken from the engines of the stern-wheel towboat *Advance* of the Kansas City-Missouri River Navigation Company. The high-pressure cylinders are 12 inches diameter and the low-pressure cylinders 24 inches diameter, the engine being arranged tandem. The stroke is 6 feet and the revolutions per minute, when the cards were taken, 26. The scale of spring for the high-pressure cards was 120 and for the low-pressure 40. The steam pressure when the starboard high-pressure cards were taken was 235 pounds gage, for the port high pressure 230 pounds, and for the low-pressure cards 240 pounds. The vacuum when the starboard high-pressure cards were taken was 20 inches, for the port high-pressure cards 18 inches and for the low-pressure cards 19 inches. According to my calculations the horsepower works out as follows:

Starboard	H. P.	91		Port	H. P.	86.5	
		90	181			88.5	
	L. P.	68					175
		74	142		L. P.	63.5	
						62	
			323				125.5
							300.5

Total indicated horsepower = 623.5.

What causes the peculiar hump in the admission lines of the high-pressure cards? M. P.

A.—Further data are much to be desired as to type of valve (poppet or slide), valve gear, character and size of receiver and designed cutoff for both cylinders. Lacking these an accurate and detailed analysis of these cards is, of course, impossible, but some points may be noted.

The peculiar irregularity in the admission and expansion lines near cutoff for the high-pressure cards is undoubtedly due to faulty valve action, which permits steam to leak through into the receiver before cutoff occurs. This may be caused (if the valve is a plain slide valve) by the valve momentarily lifting from its seat, or if the valve is of the piston type by an improperly machined valve chest, and therefore a non-cylindrical interior.

The continued reduction in the pressure of the exhaust lines of both ends of both engines indicate serious wire drawing, probably in the exhaust ports to the receiver, or possibly in the admission ports to the low-pressure cylinder, although this is improbable on account of the increased area available due to the increased size of the low-pressure cylinder. With a properly operating valve and sufficient port openings the engines should indicate considerably higher in both cylinders, and probably the gain would be more noticeable in the low-pressure cylinder. The low-pressure cards were not taken simultaneously with the high-pressure, nor even approximately so, as the boiler pressure and vacuum for both engines are radically increased from those existing when the high-pressure cards were taken. This, of course, vitiates their value for the determination of total indicated horsepower, and moreover precludes an accurate analysis of engine action; for example, the exhaust pressure at mid-stroke for the high-pressure cylinder, read from the card, is approximately 20 pounds gage, and the pressure from the corresponding position of the low-pressure card is 4 pounds higher. Taking account of piston rods, the horsepower developed in the various cylinders is as follows:

Starboard—

High Pressure			*Low Pressure*		
Head end.....	80.8	152.2	Head end.....	71.0	135.1
Crank end.....	71.4		Crank end.....	64.1	
Total, 287.3					

Port—

High Pressure			*Low Pressure*		
Head end.....	78.5	149.6	Head end.....	60.1	120.4
Crank end.....	71.1		Crank end.....	60.3	
Total, 270.0.					

Total both engines, 557.3

In general, however, there seems to be no serious defect shown in the low-pressure cards, and while the low-pressure cylinder is doing less than half the work, in the case of the tandem compound engine this is unimportant, as both pistons are on the same piston rod.

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Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Cracked Cylinder Flanges

The bottom after flanges on the steam cylinder of a tug cracked where they join the engine frame. As it was necessary to use the tug before a new cylinder could be cast, something had to be substituted for the flanges in order to hold down the cylinder.

The engineer obtained two long bolts and a strap of iron, something like an "old man." Two holes were drilled in the iron strap to receive the bolts. The strap was then placed across the top of the steam chest, which faced aft, and the bolts inserted to connect it to the cylinder frame, the bolts passing through the same holes in the top of the frame that were used for the flange bolts.

This arrangement has served its purpose for about three months, giving very little trouble. A new cylinder has been cast, however, and is ready to install on short notice.

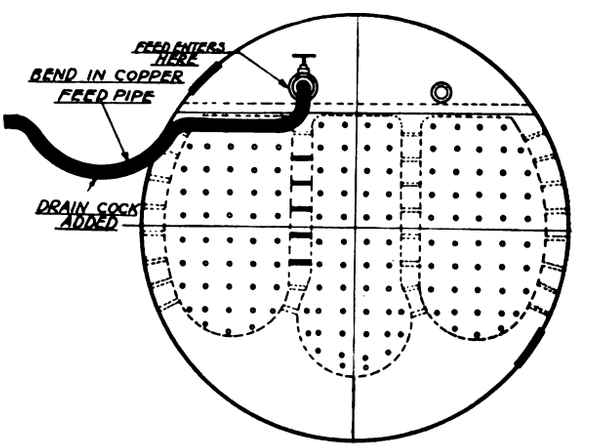
G. T. C.

An Interesting Case of Boiler Corrosion

Some time ago, while serving as assistant engineer on a large cargo boat, the writer ran across a rather interesting and instructive case of boiler corrosion. Boilers are a great problem to engineers and the wherefore of corrosion has caused us many sleepless nights. Some problems are fairly easy to solve, but, then again, a great many go unsolved; again, we sometimes find the cure without getting at the bottom of the trouble, but the only real satisfaction is experienced when we find the trouble and remedy it. The writer believes that a freer exchange of experiences between engineers would be very helpful to us all.

A brief description of the vessel's machinery will help in explaining the difficulty we had in this particular case. We had a triple-expansion engine of about 1,800 indicated horsepower, which ran at 65 revolutions per minute. The air and circulating pumps, both of the bucket type, were run of the intermediate crosshead by the regular link arrangement. On either side of these pumps were arranged in pairs a feed and a bilge pump, both of the plunger type. The feed pumps drew from the hot well and discharged first through a closed type feed heater, where the feed water was heated to a temperature of about 180 deg. F. The feed was then passed through a cartridge type filter and then into the boilers. The boilers were of the ordinary Scotch type, three in number, coal burning, natural draft with a working pressure of 180 pounds per square inch. The pumps and heater were on the port side of the engine and the boiler which gave us trouble was the starboard boiler. The check valves were in the engine room, for the boilers projected through the bulkhead between the engine room and boiler room. The arrangement brought the check valves very high up on the boiler and very close to the combustion chamber side and back stays. No internal feed pipe was fitted.

The first signs of corrosion we found were on the stays from the combustion chamber back to the boiler back head on the center chamber. The stays from the center chamber to the port chamber were also affected. All of these stays were nearly directly under the check valve. The stays were badly wasted away and some were down to less than half the original sectional area. At first it was puzzling that this corrosion should be so marked locally, but when the location of the check valve is considered, along with the fact that the feed pumps were of the plunger type, and that the feed was heated in a closed heater on the pressure side, and thus only to 180 degrees, it is easily understood. Plunger pumps of this type directly coupled to the main engine are as conducive to mixing air and water as they are to pumping, and the closed heater combined with the low final feed temperature did not remove a great deal of the air and, when finally this comparatively cold water was pumped into the boilers and onto the hot combustion chamber plates, conditions for local corrosion were ideal.



Arrangement of Feed Pipe

However, this did not explain why the corrosion was so much more apparent in the starboard boiler. Of course, its location relative to the pumps and heater would account for a slight amount of extra corrosion, but the difference was too great to be explained in this way. The chief engineer asked for the installation of a pump for an independent feed pump, believing that it would do away with pretty nearly all of this corrosion. The owners, however, were not convinced that this was necessary, so the pump was not installed. All the corroded stays were replaced by new ones before the boilers were set off for another voyage.

Upon opening the boilers again after reaching the end of a long trip we still had this excessive wasting away in the starboard boiler, and we were up against it to find the cure.

Finally, after eliminating all other possible causes, we hit upon that of galvanic action. At first we could not find anything that would cause this action because the boiler was well supplied with zinc plates. The real trouble we hit upon more by accident than intent. The feed pipe just before entering the starboard check valve had a downward bend, as shown on the sketch. This was, of course,

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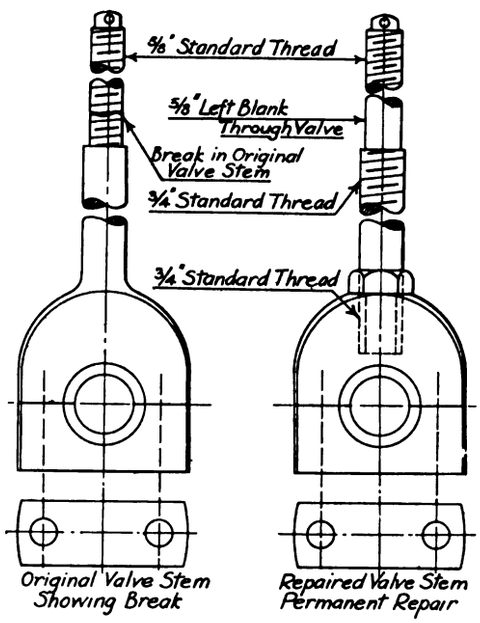
to take up any expansion in the copper pipe, but it also formed a water pocket. When the pumps were stopped a certain amount of water collected in this pocket and could not be drained off. The water was warm and was permitted to stay there for a week or more at a time while we were in port loading or discharging part of a cargo. The pipe being copper, caused a small chemical action between the pipe and the water, which caused the latter to become very acid. When the pumps were again started all this acid was pumped into the starboard boiler and onto these combustion chamber back and side stays and caused this excessive and rapid corrosion. This theory seemed perfectly logical, so it was decided to fit a small drain cock at the lowest part of this bend, as shown on the sketch. The cock was opened when the pumps were stopped and all the deposited water was drained out. After making this simple and inexpensive repair the boiler showed no more signs of any further local corrosion.

F. KILIAN.

Quick Emergency Repairs

The element of time is often of most serious consideration in making emergency repairs and more particularly so in express steamers carrying mail and passengers where detention amounting to fifteen or twenty minutes may cause missing a through train connection. When the emergency arises the problem to be settled at once is what


⅝" Standard Thread
⅝" Left Blank Through Valve
Break in Original Valve Stem
¾" Standard Thread
¾" Standard Thread
Original Valve Stem Showing Break
Repaired Valve Stem Permanent Repair

Repairs to Broken Valve Stem

can be done to make port with the least possible loss of time; of course, always considering "safety first."

One morning at two o'clock the engineer on watch reported to me that the circulator had stopped, and when I got below he had opened the valve chest and we found the valve stem broken off just under the bottom lock nut. We had no spare stem aboard and there was no arrangement provided for running jet condensing; also there was no connection from the fire pump to the condenser. Briefly, the main engine was out of commission until we could "fix" the circulator.

The stem was threaded all the way from the top down through the valve to about ⅜ inch below the bottom lock nut. We squared the broken ends off roughly with a file and screwed the thick nut down to the limit of the thread on the lower, broken end. This took about half the nut. We then screwed the upper part of the stem down into the nut, thus using the nut as a sleeve coupling. The lock nut was then put on and enough washers to bring the valve up to its correct position.

Putting the nuts on the stem above the valve and the cover on the steam chest required a few more minutes, and we were under way after a delay of just twenty-five minutes. By driving we got in about five hours later, practically "on time."

Of course this repair could not have lasted very long, but it got us in, and that was all we required of it, as we had ample time to make permanent repairs before sailing again that night.

We were lucky to have enough of a threaded end below the break to catch the nut on without having to take the stem out and thread it, but the point is that the engineer must instantly see any possible advantage and use it with the least possible loss of time.

On another occasion the cap screw holding the lever on the end of the rocker-arm of the twin-beam Blake air pump broke off flush with the end of the shaft. The lever referred to actuates the valve gear and is bolted to the end of the shaft, the large boss of the lever forming practically an extension of the shaft. The boss of the lever is held central by a light recess turned in the end of the shaft to receive a corresponding projection on the boss of the lever. Two dowel pins hold the lever in its correct radial position, hence the bolt is only required to hold the lever securely against the end of the shaft.

We could not start the bolt out with a chisel, and we could not get a drill at it in place, because the 6-inch discharge pipe came up directly in front of it with only about three inches space between it and the end of the shaft. We cut out a block of wood that, together with a piece of plate for the bolt-head to wear against, just fitted tightly in the space between the bolt-head and the discharge pipe and drove it in, holding the lever up against the end of the shaft.

We were stopped twenty minutes, and while making this repair I did not think it would last half an hour, but it was the only thing we could do that would not require two or three hours' detention. As a matter of fact, it lasted until we got in, which we did practically on time, about five hours after the accident.

Referring again to the broken circulator valve stem, a glance at the accompanying sketches will show how the permanent repair was made. The new design gives the necessary additional strength where needed, with the further advantage of quick and cheap renewals of the stem when badly worn or broken. It would be to the advantage of all concerned if the designing engineers would pay more attention to these insignificant (?) details.

This stem is fitted for a slide valve in a pump with an 8-inch cylinder providing condensation for a main engine and auxiliaries of approximately 2,500 indicated horsepower, and the veessel was built in one of our foremost shipyards less than five years ago. S.

A Boiler Failure

A boiler, about fifteen years old, on a river tug developed several bad leaks in the back sheet. After laying up the tug all night, the engineer found no water in the glass or gage cocks. This had happened on previous occasions, however, due to the leaks in the back flue sheet.

The steam pressure was low and the engineer turned on the steam jet to blow the fire, but neglected to bring the water level up. When the fire became hot, the tubes

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above the three lower rows drew away from the sheets, front and back, showing that the level of the water must have been down to the top of the third row of tubes from the bottom.

This was clearly a case of neglect on the part of the engineer. In the first place, when there is no water in the gage glass and, especially, in the gage cocks, it should be attended to immediately. In the second place, the leaks in the tube sheet should never have been neglected for so long a time. No doubt the failure would have occurred in as short a time if only the first condition obtained that of a low-water level. G. T. C.

Size of Inboard Bearings, Proper Design of Crossheads and Faults of Lubricating Systems

Being Scotch, I have the right by tradition to believe in the mysterious and to be superstitious.

When I first went to sea I listened to the stories of feed pumps that pumped water that never reached the boiler or went anywhere; of boilers that exploded with half their working steam pressure or burnt out when all hands, from the first water tender down, swore that they all knew that at the time of the accident there was a full water gage; of the stop valves that, when wide open, passed no steam, and so on, and believed in them.

My faith in the mysterious was upset and shaken when, being sent aboard another steamer of the line to take the place of a sick "third," I found the engine room in a mess, as a low-pressure piston had given away just as they were warming up and turning over. Happening to push aside a jumper lying on a shelf near a port hole, I saw a very-much-distorted spanner and a chunk of cast iron, on which was plainly visible the imprint of the head of the spanner, and if the captain, who was later looking over the side, had had sharp enough eyes he could have seen the "mystery" disappearing in the water.

Yet, Mr. Editor, in all seriousness, here is a mystery. Why is it that no amount of argument or suggestion from those of us who stand on the gratings can induce designers to do certain things which our experience shows would be advantageous? For instance, we all know that the inboard bearing of the main engine always wears low. From my experience, this is the inevitable condition; yet designers persist in making this bearing too small. They argue that there is no power transmitted through this bearing save that necessary to run the valve gear, and that if they should attempt to make it long there would be too much offset to the rods, "and, anyway, it isn't necessary."

I have gone to the extent of taking a designer down to a speed lathe and showing him how a bit of wire held in the chuck will flop around when run at speed, and called attention to the fact that this was similar to a crankshaft, and was for my pains called "a crank." I saw once in an American compound just the right design for an inboard bearing. The engine was a small one, and the valve gear drove straight up, and a comparatively short bearing was provided between the crank cheek and the eccentric, but outside this, in a solid bracket cast on the bed, was a very long bearing; the eccentric, therefore, worked in a pocket. The engineer in charge told me that he had been running the boat three seasons, and that the crankshaft was in perfect line.

Now, this design was simple enough, and when I showed it to one designer the only argument he had against it was that "everybody would be tumbling over it when they passed around the engine."

When I go into an engine room for the first time I cast my eyes at once on the cross-heads, and I believe this is what every engineer does, because a cross-head gives more trouble than any other part of an engine; that is, as far as my experience goes. To my mind, there is only one design of cross-head which is proper, and that is not common in commercial engines. It is the one where the pin of the connecting rod is shrunk in and the cross-head has a single brass. Usually the forked end of the connecting rod is furnished with two brasses, necessitating two overhung pins (which are never large enough in diameter), and making the exact adjustment and even pressure on each of the brasses impossible, so that there is an uneven wear on them. The designers always shudder with horror when you suggest larger pins—"they weigh more." Sometimes they will concede an extra half inch in length, which I contend is no where near so good as an increase in diameter; yet the idea of setting the cross-head slide a little further back from the center, in order to provide clearance on account of the increased diameter of the pins, is another thing which disturbs the designer's equilibrium.

With the pin shrunk into the connecting-rod end you have a beam supported at both ends, the advantage of which we all admit, and a single brass to adjust. This style is no novelty; yet I have never but once seen it in a commercial engine of large size.

When I first got into the engine room it was under a chief who had the sign habit. He had little placards stuck up on the bulkhead in the shape of proverbs. One was: "A drop of oil where wanted and when wanted is worth a barrel in the crank-pit." Oil, Mr. Editor, is one of the most disobliging things in the engine room; it is lazy and always wants to get away from its work, and you have to make it go where it should. We know that it will never work into a bearing; it will always work out—that we are sure of; yet the filters will usually provide means in the shape of grooves which conduct the oil off the bearing as soon as possible, and so place them that when the thrust for lift on the bearing will cut them off just at the moment when the oil is most needed. A forced system of lubrication is, of course, ideal, provided you have means of knowing that it is constantly working, without waiting for something to run hot. The ordinary gravity feed oiling system is infinitely improved by having the oilways lead the oil to the sides of the bearing, instead of to the top, as usual.

In a crankshaft I insist that there should be three oil holes drilled each side of the center, but instead of the holes leading directly down to the shaft, they should lead to the side of the bearing, coming out at a tangent. This introduces the oil on to the bearing where there is the least pressure, allowing room for the oil to smear itself over the surface. This makes a little more work in the machine shop, but results in far less anxiety for the engine-room force.

Can you get the average designer to show oilways made as described? As they say in the States: "Not on your life!" When it comes to forcing oil through pipes it seems to be forgotten by those who erect piping that oil is not free from dirt and that ample means should be provided for thoroughly cleaning out oil tubes every now and then, and doing it quickly. It is quite common to have a large tube running fore and aft on an engine, with branches from it leading over to the main bearing; for instance, these branches are usually curved and look real pretty, but I want, instead of this curved tube, two straight

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pipes—one horizontal and one vertical, with a tee connection; one of the three holes being closed with a plug having on it a knurled headed plug, so that it can be quickly taken out and returned without the use of a wrench. Of course, these tubes, fittings and plugs should be of composition.

Any system of oil tubing should be connected up to a steam supply, so that it can be blown through. Now, with this system of tee and plug, the steam can blow out all the tubing except the vertical, short run down from the tee to the bearing, without blowing the dirt into the same.

The experience of human beings will, of course, vary, and it may have been only my personal experience that leads me to make the above remarks; yet, in talking with my brother engineers, I find them invariably agreeing with me on the points to which I have drawn attention.

ANTI-MYSTERY.

Bearings for Shafts, Etc.

The duty of a crank bearing is to take up the pull or push which is exerted on the shaft. Before the shaft turns, the friction moment must be overcome by a turning moment. This friction moment is a certain loss, and therefore it must be made as small as possible. If P is the load on the bearing and f the coefficient of friction, then the frictional resistance $= P \times f$. But this is only true for dry surfaces, or for surfaces which are lubricated with graphite.

It is commonly asserted that the frictional resistance is not dependent upon the velocity of rubbing, but this is also only true for dry surfaces. For bearings with oil we have the equation:

$R = f \times p^n \times v^m$ where,

R = force of friction acting on every square inch of bearing surface.

f = a constant.

p = the normal pressure in pounds per square inch.

v = velocity of sliding surface.

^{n} = an exponent depending on the value of lubrication and varying between 1 for dry surfaces and .4 for ring-lubricated surfaces.

^{m} = an exponent also depending on the lubrication and varying between 1 for dry surfaces and .5 for surfaces moving in an oil bath.

The material of the rubbing surfaces, if these are well lubricated, has only a secondary influence on the friction, but it has an influence on the quantity of oil which must be fed, and also such materials must be selected as will run if the lubrication is stopped for a short time. In most cases the steel shafts or pins of marine engines run in white metal lined surfaces, but only where the bearings are not exposed to shocks; in crosshead bearings, and the bearings for the pump gear, the white metal may better be omitted.

The only reason why white metal is better than bronze is that, it being plastic, it accommodates itself exactly to the journal, so that the shaft does not bear on some one point, as it is likely to do with a bronze bearing, which point must be scraped away in order to get a good bearing surface. Cast iron on cast iron runs very well, but with such conditions great care must be taken or this material will grip. Serious accidents have occurred with cast iron eccentric straps running on the cast iron sheaves. Cast steel crosshead shoes on cast iron slides run very well and need little oil. The crosshead pins and the pins of the valve and engine pump gear nearly always work in phosphor-bronze bearings; formerly it was tried to have the pins and bearings of hardened steel and truly ground. In many cases little trouble was experienced, but at times a breakdown took place, owing to the gripping of the ground pin and bearing.

On the torpedo boat *G* this practice was in use in connection with the valve gear, the links also being hardened and ground and provided with hardened bushes. On the first trial trip, when running at about 400 revolutions per minute, the ahead eccentric pin and bush gripped; a heavy knock was heard, after which the engineer closed the stop valve as soon as possible. It seemed that the eccentric, which was of 5 percent nickel steel, had broken close to the forked end. The color of the material was a dull blue. The pin could not be moved after it had gripped, so the shaft turned the eccentric, which was only made possible by the bending of the eccentric rod, and it soon broke. The violent moving of the molecules caused considerable heating of the rod. The rectangular section of the rod at the point of breaking was 1⅜ inches by ⅝ inch and the rod was nickel steel.

The high-pressure piston valve was taken out and the boat steamed with reduced steam pressure to the engine works, where a new rod was made.

Very often the pins are of nickel steel and the bearings of phosphor-bronze. This steel is of a very fine structure and, being harder, the wearing is less than with common Siemens-Martin steel. But the best of all for crosshead

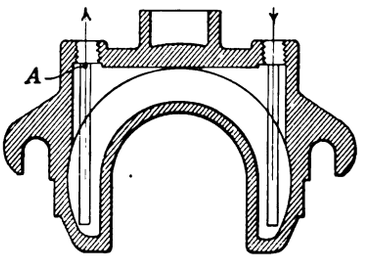

Fig. 1

bearings and valve gear and pump gear is a hardened and ground pin on a hard bronze bearing. The wear with this construction is very small and, in the writer's practice, it has occurred that after six years' running it was not necessary to remove even one of the thin plates or shims inserted between the brasses from the crosshead bearings of a triple-expansion engine running at 150 revolutions per minute.

For thrust bearings it is always the best to have the iron or cast steel segments lined with white metal and provided with ample oil grooves. It must be remembered, however, that it is not good practice to have a single hole from the oil cup divided into two leads, one to the ahead and one to the astern faces, as is often provided. When the rings get a little play, all the oil, when running ahead, runs to the astern side, so that the ahead side is not sufficiently lubricated.

To have the segments hollow, with cold water circulating through them, is excellent practice. It must not be forgotten that a hole must be drilled at *A*, Fig. 1, to allow the air to escape, or the air will be trapped and the cooling water will not reach all the rings. The water service piping is most commonly connected to the inlet and outlet of the circulating water, which gives a good flow of cold water.

The only trouble with cooling the thrust-bearing segments is that, if they heat up quickly, they still feel cold for a time, so that the engineer is misled.

D. K.

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Marine Articles in the Engineering Press

New Harbor Improvements—Naval Topics Brought Up by the European War—Interesting Discussion of High-Speed Bearings

Protection Against Fire On Board Ship.—It is stated that, although great developments have taken place in every detail of the design of merchant steamships, little or no progress has been made towards the effectual protection of the ship against fire, except in the pumps and distribution of pressure water from them. The question is not only one of preventing a possible outbreak, but of quickly and effectually arresting it in the initial stages. A review of the methods used on board ship and also in warehouses, etc., shows that the automatic sprinkler system is used quite extensively. An improvement in this system, in the form of a differential valve with water pressure on one side and air pressure on the other, eliminates the possibility of the water freezing. This is called the dry-pipe system and the water is released when the air pressure in the pipes is relieved by the melting of the solder in the nozzle. Where such systems are impossible, as in cargo holds, a system introducing carbon dioxide is used to advantage. Sulphur dioxide has been used, but one authority found it objectionable, claiming that men could not live in an atmosphere containing any appreciable amount of the gas. The use of steel furniture and the substitution of light steel and plaster for wooden decks, cabins, partitions, etc., is said to be largely a question of expense. There can be no question that a ship so treated would be more immune to fire than an ordinary vessel depending largely on the fire-pumps; but the final answer, it is feared, is one concerned with the relation of safety and its influence on earning power, to the cost involved. Shipowners have shown such readiness to add to the comfort and speed of their vessels that there is no doubt they will meet the demands that are commercially practicable. 1,400 words.—*Engineering,* July 10.

The Port of Calcutta.—The congestion of trade at the premier port of the Indian Empire is bound to have a disturbing influence over a wide area, apart from the consideration that during the past few years it has become only too evident that the inability of the port authority to cope satisfactorily with an ever-increasing volume of commerce was seriously impeding the growth and development of the port and undermining its prosperity. From time to time committees have been appointed to inestigate the conditions and make recommendations for a solution to the complex problem. It remains to be seen whether the proposals now put forward by the present committee will meet with any more favorable fate than any of their predecessors. Sea-going shipping at Calcutta has hitherto been accommodated either at jetties in the River Hooghly or at the Kiddepore Docks. The jetties have been conspicuous for the degree of congestion prevailing along their frontage, and for the inadequacy of their facilities for the discharge of cargoes. At the docks the defects are in regard to insufficiency of accommodation and an unsatisfactory entrance arrangement. The quayage of Dock No. 1, which was formerly adequate for twelve vessels, now only suffices for eleven, and sometimes for ten. The defects of the entrances are even more serious and vital. There are two entrances—one a lock, 60 feet wide and 400 feet long between gates, and the other a simple entrance 80 feet wide with a single pair of gates. Both are inadequate for modern shipping. The proposals in regard to dock extension put forward in 1906 are practically identical with those which now receive the approval of the Commission. The scheme comprises a new dock system on land which has already been acquired in the vicinity of Garden Reach, consisting of a turning basin or main dock, with a minimum dimension of 1,000 feet and two arms or branch docks, running approximately north and south, with widths of 600 feet and 700 feet respectively. The depth of the dock is fixed at 35 feet. The entrance is designed to allow continuous docking and undocking of vessels throughout the twenty-four hours. It is proposed that the lock shall have a length of 1,200 feet, divisible into two sections of 700 and 500 feet, by which it will be possible to pass either one or two vessels through the lock at a single operation, saving time and water. The width proposed is 90 feet but 100 feet is preferable. The Commission advocates the inception of the new dock, comprising five internal berths and its entrance, together with five riverside berths at Garden Reach, a distributing depot at Beliaghata for the delivery of imports from the docks, an enlarged junction yard for the reception and despatch of railway traffic, and the realinement of the Budge-Budge branch of the Eastern Bengal State Railway. The recommendations involve an immediate expenditure of about $14,400,000. 1 illustration. 2,000 words.—*Engineering,* July 17.

The East Harbor of Berlin.—To improve the waterborne traffic of Berlin, the east harbor was established upon a narrow waterfront of the river Spree of about twenty-five acres. It shows a central stowage space in buildings or ground and railroad tracks on each side, covered by elevated crane tracks on the water side. The buildings, some up to eight stories high, are prepared for reception of grain and package freight, while bulk freight may be stored outside. The necessary elevator cranes, chutes, conveyors, etc., are fitted, all driven by electric motors. The buildings are stated to be substantial fireproof constructions of pleasing architectural design. Special care is given to storage of gasoline (petrol), with all the latest safety appliances. The power-plant contains two 350 horsepower and one 175 horsepower Diesel engines, direct connected to 500-volt, direct-current dynamos, and supplemented by a storage battery of over 1000 ampere hours. The total cost was approximately $4,300,000 (£880,000), with a capacity for about 37,000 tons grain and freight. 30 illustrations. 9,300 words.—*Zeitschrift des Vereines Deutscher Ingenieure,* July 4 and 11.

Tension Measurement on Board Ship.—The modern search for greater clearness and fuller knowledge is extended in this article to the critical consideration of strength calculations of ships and their possible supplement by experimental determination of material extensions of the incorporated parts of the structure. It is pointed out that aside from the longitudinal stresses of the hull in toto, so many local stresses in their statical as well as their dynamical aspect enter the problem of rational judgment, that the author thinks experimental compilation of extensions the only reliable source of knowledge on this complicated subject. There is described the Marten's mirror apparatus, used by the author in his experiments, consisting of only a short measuring bar, sometimes not more than 8 inches long, a mirror, camera with

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lens and film and a source of electric light. The conclusions the author arrives at from measurements on winter voyages of the North German Lloyd steamers *George Washington* and *Bremen* are that the observed longitudinal stresses are less than usually obtained by calculations, and that liability to fracture is more pronounced from sudden impacts by waves and from fatigue of the metals. 23 illustrations. 6,600 words.—*Zeitschrift des Vereines Deutscher Ingenieure,* July 18.

The Application of Electricity on Merchant Vessels.—The history and development of electric installations on board merchant vessels are exemplified in this article by successively built ships of the North German Lloyd Company. It shows the gradually increasing size of the lighting plant with different dynamo combinations, one or two wire lines, special emergency sets, direct current versus alternating current, influence on compasses and dynamo construction. Further are pointed out the widely extended application to power purposes in winches, ventilators, pumps and to heating, also the preference of manually controlled shunt dynamos over compound dynamos and installations of storage batteries to take peak or minimum loads. The advantage of economical reciprocating steam engines, as described, over turbo sets is mentioned particularly for cargo vessels with reciprocating engines. Some new electric engine and navigation telegraphs are described, which by alternating-differential currents produce a very definite indication of signals. Electric winches of the small speed and portable type are finally considered. 30 illustrations. 7,000 words.—*Zeitschrift des Vereines Deutscher Ingenieure,* June 13.

The Submarine in Naval Warfare.—Admitting that the submarine has proved a serious menace and warrants the most vigilant precautions against its attacks, it is pointed out that as a weapon of destruction the submarine is not yet perfect. So far in the present war, submarines have failed to prevent an effectual blockade of a belligerent coast. Of four known attacks delivered by German submarines, three have been repulsed with loss to the enemy, and it seems evident that improvement and development in the vital features of submarine design are necessary before such vessels will attain the offensive value credited to them by theorists. As yet experience is lacking as to the effect of a torpedo attack on a capital warship. The question of defense against submarines should nevertheless be carefully considered. The present methods used by the British fleet are fleet tactics, gun fire and mine and nets. The first two have proved successful so far in the present blockade operations, but the experience of the past three months leads to the conclusion that a new fleet unit must be evolved, capable of repulsing under water attack. It is expected that the present naval warfare will furnish the necessary data for developing a suitable design for such a craft. 1 illustration. 1,300 words.—*The Shipbuilder,* November.

Cargo and Passenger Steamers for British Guiana.—Six twin screw passenger and cargo steamers, designed to meet the general requirements of service in tropical climates, have recently been built and engined by Messrs. Philip & Son, Ltd., Sandquay Engineering Works, Dartmouth, to the order of the Crown Agents for the Colonies. The vessels are named the *Arawana, Arapaima, Baira, Haimara, Lukanani* and *Pirai,* and were launched in the order named, the latter having been completed in September. The boats are 100 feet long between perpendiculars, 23 feet molded beam, 9 feet molded depth and 7 feet normal load draft. They are single-decked vessels with the space below the main deck subdivided by four watertight bulkheads, the machinery being in the central compartment with a cargo hold both forward and abaft of the machinery. Accommodations for 75 first class day passengers are provided on the main deck and 15 first class passengers on the promenade deck. The third class accommodation is on the after part of the main deck, while the crew is berthed in the forecastle. The propelling machinery consists of two sets of compound surface condensing engines, having cylinders 10 and 20 inches diameter and 14 inches stroke, designed to run at 170 revolutions per minute, giving the boats a mean speed of 10 knots. Steam is supplied by a return tube boiler 11 feet diameter by 10 feet 6 inches long, working under a pressure of 140 pounds per square inch. 4 illustrations. 1,000 words—*The Shipbuilder,* November.

Parsons Marine Geared Turbines.—One of the common objections raised against the turbine system of propulsion is that it does not conduce to easy handling or maneuvering of a vessel. As evidence that this objection is not well founded, the case is cited of H. M. S. *Badger,* the first British warship to be fitted with geared turbines, which recently rammed and sank a German submarine boat. Further proof is offered in the operation of war vessels at the "Fight of the Bight." The strongest evidence is found, however, in the case of the new Cunard liner *Transylvania,* a ship 567 feet long, 66 feet 6 inches beam and 45 feet depth, which is the first transatlantic liner to be fitted with geared turbines. The machinery is arranged to drive twin screws, a high-pressure and low-pressure Parsons reaction turbine being fitted to each shaft through the medium of spur gears. The gear wheels are 10 feet diameter and 5 feet broad. At full power the turbines run at 1,630 revolutions, while the propellers turn at the rate of 130 revolutions per minute. The full power is 9,500 shaft horsepower and the speed 16½ knots. The steam consumption of the turbines is only 11½ pounds per hour per shaft horsepower. Further attention is attracted to geared turbines in a paper recently read before the Institution of Engineers and Shipbuilders in Scotland, which gives particulars of the machinery for a number of vessels typical of various classes and for the same ships, designs, weights, etc., of geared turbine installations. While these data are more or less empirical, they nevertheless show the distinct advantage gained from the reduced steam consumption in geared turbine installations over the ordinary reciprocating or turbine drives. 1 illustration. 1,000 words.—*Engineering,* October 30.

New German and Austrian Warships.—The latest battleships for the German fleet are of the *König* class, of which three are completed and a fourth is rapidly nearing completion. These battleships are 580 feet long, 97 feet beam, 27½ feet mean draft, 26,575 tons displacement, armed with ten 12-inch, fourteen 6-inch and ten 3.4-inch guns and five submerged torpedo tubes. They are propelled by three sets of turbines, designed to develop 28,000 horsepower, supplied with steam by fifteen Schulz-Thornycroft boilers. The designed speed is 20½ knots. The main armor belt is 13.7 inches thick amidships, tapering to 6 inches at the bow and stern. This is surmounted by 8-inch armor and the usual 3-inch protection deck is provided. The main battery is mounted in five two-gun turrets all on the centerline of the ship. When compared with their contemporaries, these ships are deficient in gun power, although they are well protected. Two new battle cruisers, the *Derfflinger* and *Lutzow* have just been added to the German fleet and are the first German cruisers to carry the 12-inch gun. The vessels are 689 feet long, 95 feet beam, with a draft of 27¼ feet and a displacement of 26,600 tons. The main armor belt is 12 inches thick, tapering to 4 inches at the ends. The armament consists

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of eight 12-inch, twelve 6-inch, twelve 3.4-inch guns and four torpedo tubes. The designed horsepower is 63,000 and the speed 26.5 knots. The latest German light cruisers are the *Graudenz* and *Regensberg*, of 4,900 tons displacement, 456 feet long by 45 feet beam, with a mean draft of 17 feet. The armament comprises twelve 4.1-inch guns and two 20-inch torpedo tubes, the heaviest armor being 4 inches thick. The turbines develop 25,500 horsepower, giving a designed speed of 28 knots. As compared with contemporary vessels in the British Navy it is pointed out that the German cruisers are inferior in gun power, although they are faster and have larger bunker capacity. The latest German destroyers are of about 650 tons, equipped with five torpedo tubes, two 24-pounders and two machine guns, with the turbines developing 16,000 horsepower, a speed of 32.5 knots is usually exceeded on trial. In the Austrian Navy the battleship *Prinz Eugen* has been completed and the *Svent Istfan* is near completion. These are the third and fourth ships of the well-known *Viribus Unitis* class displacing 20,000 tons, carrying twelve 12-inch and twelve 6-inch guns. The speed is 21 knots. Three light cruisers of the *Spaun* type, displacing 3,500 tons and driven by turbines of 25,000 horsepower at a nominal speed of 27 knots, have also been added to the Austrian Navy. They are equivalent to the British *Active* class, having an advantage of two knots in speed, although they are inferior in gun power. The new Austrian destroyers, each displacing 800 tons and having a speed of 32 knots, carry two 3.9-inch guns and four 12-pounders, as well as two torpedo tubes. 8 illustrations. 1,850 words.—*The Shipbuilder*, November.

Aeronautics.—By Algernon E. Berriman, M. I. A. E., A. F. Aé. S. A brief description of airships and aeroplanes leading up to the problem of equilibrium in the air. 5 illustrations. 4,100 words.—*Transactions of the North-East Coast Institution of Engineers and Shipbuilders*, September.

Wireless Telegraphy.—By H. Fothergill. A very complete paper explaining the theoretical and practical development of wireless telegraphy, including detail descriptions of all common wireless systems. 27 illustrations. 10,000 words.—*Transactions of the North-East Coast Institution of Engineers and Shipbuilders*, September.

High Speed Bearings.—By Gerald Stoney, F. R. S. In discussing the three principal types of friction in all bearings—that is, constant friction where both surfaces are dry, greasy friction where there is a more or less complete film of oil between the surfaces, and complete lubrication where there is a complete oil film between the surfaces and no metallic contact—the author refers to the experiments of many investigators. Tower's experiments showed that friction is nearly independent of the load and much smaller than is generally supposed. He also directed attention to the fact that the weight on the bearing was really borne by the oil film, which is thicker at the incoming than at the outgoing edge, and that the oil must have a certain viscosity proportional to the pressure. Tower experimented with a bearing 4 inches diameter and 6 inches long, the brass embracing a full half circle and being accurately scraped to an easy fit to the shaft. The brass was on top and the shaft dipped into an oil bath so as to insure complete lubrication. He showed that the oil film was under very considerable pressure and demonstrated the distribution of pressure. The general result was that with olive oil at 90 degrees Fahrenheit the friction was nearly independent of the pressure and increased approximately as the velocity, $V^{0.8}$. Goodman experimented with a bearing 2 inches diameter and 4 inches long running at 233 revolutions per minute, equivalent to a surface speed of 2.04 feet per second, with an oil bath maintained at a temperature of 40 degrees Centigrade, and found little difference with loads varying from 50 to 550 pounds. He also found that the total friction was proportional to the arc of contact, which he varied from the full arc of 2 inches down to ½ inch, the shear resistance being constant at .36 pound per square inch taken on the chord of the arc of contact. This reduction of the arc of contact has been used in railway journals to reduce the friction. The principal published experiments on high speed bearings are those of O. Lasche. From his experiments it is evident that the material of the journals and bearings makes little difference, as would naturally be expected when the machinery is entirely supported by an oil film. At the higher temperatures all the oils would seem to yield about the same results, while the friction is roughly inversely proportional to the temperature reckoned from freezing point. The general result of the experiments is that approximately up to $v = 2.5$ meters per second the friction varies as the square root of $V^{1/2}$; from 2.4 to 4 meters per second as about $V^{1/6}$; and above 10 meters per second is nearly constant. These tests show that so far as friction is concerned it is not well to use a large shaft and a long bearing, but experience shows that for high speeds and heavy loads long bearings are necessary, and they also have to be large to avoid vibration and critical speeds, and also the risk of fracture due to vibration. In turbine work a rule much used for deciding the size of bearings has been that the product of the speed by the pressure should not exceed a certain figure; but it is doubtful whether this rule is of much value, as it really assumes greasy friction and not perfect lubrication. In land work a product of 5,600, or 75 pounds per square inch at 75 feet per second, has rarely been exceeded. At lower speeds, higher pressures are used satisfactorily. In a discussion before the American Society of Mechanical Engineers, it was stated that speeds of 80 feet per second and 100 pounds per square inch were commonly employed in America, and where there is no risk of heavy vibration there does not seem any reason why higher pressures should not be used. In marine turbines the journal speeds are much lower than on land, and rarely exceed 30 feet per second, and the pressures are usually 80 to 100 pounds per square inch and it is probable that pressures of 150 pounds, or even possibly 200 pounds, per square inch could be used, especially if the oil temperature does not exceed 100 to 110 degrees Fahrenheit, as is usual in marine work. In all high speed bearings artificial means have to be used to carry off the heat, radiation from the bearings not being sufficient. The general plan is to have such a flow of oil from the bearing as to cause the heat generated to be carried away without an undue rise of temperature. Water-jacketing the bearings has been used in some cases, but is not as satisfactory. 13 illustrations. 4,000 words.—*Transactions of the North-East Coast Institution of Engineers and Shipbuilders*, August.

MONTHLY SHIPBUILDING RETURNS.—The Bureau of Navigation, Department of Commerce, reports 100 sailing, steam and unrigged vessels of 21,724 gross tons built in the United States and officially numbered during the month of October. Eight of these vessels were steel steamships, aggregating 13,037 gross tons. The largest vessel completed during the month was the *Great Northern*, of 8,255 gross tons, built by William Cramp & Sons' Ship & Engine Building Company, Philadelphia, for the Spokane & Seattle Railroad Company.

INSTITUTION OF NAVAL ARCHITECTS.—The next annual meeting of the Institution of Naval Architects will be held in London on March 24, 25 and 26.

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New Books for the Marine Engineer's Library

Some New Books on Boilers and Revised Editions of Old Ones — A New Edition of Simpson's Naval Constructor

STEAM BOILERS. By E. M. Shealy. Size, 6¼ by 9⅜ inches. Pages, 350. Illustrations, 184. New York and London, 1912: McGraw-Hill Book Company, Inc. Price, $2.50 net.

As this book is intended for the use of firemen and others who are in responsible charge of boiler rooms, it is given over almost wholly to the subject of the operation of boilers rather than to their design. Chapters on the chemistry of combustion and fuels form a basis for the study of the proper burning of fuels. These are followed by descriptions of firing and smokeless combustion of coal. Chapters are also included on the care and inspection of boilers and boiler testing. As a text-book for correspondence students, for which it was primarily written, it is excellent for practical study, and although it does not refer especially to marine practice, nevertheless it should be a valuable asset to those operating any type of boiler.

OIL FUEL FOR STEAM BOILERS.. By Rufus I. Strohm. Size, 5 by 7 inches. Pages, 140. Illustrations, 63. New York and London, 1914: McGraw-Hill Book Company, Inc. Price, $1 net; 4/2 net.

This book is one of the series, called the Power Handbooks, which is frequently referred to as the "Best Library for the Engineer and the Man Who Hopes to be One." The purpose of the volume is to describe the underlying principles in the use of oil as a fuel for steam boiler practice. The construction and operation of various types of burners, together with their arrangement in different boilers and the operation of pumps, heaters, etc., are described clearly and in many cases by excellent drawings. No special reference is made to marine practice, as the subject matter is confined to stationary boilers.

MARINE STEAM. Second Edition. Size, 7½ by 10½ inches. Pages, 220. Numerous illustrations. New York and London, 1914: The Babcock & Wilcox Company.

While this book is issued as a catalogue descriptive of the boilers manufactured by the Babcock & Wilcox Company, the engineering data given, showing the results obtained with watertube boilers in a great many different installations, are of great interest and value from an engineering standpoint. A short historical review of the development of the Babcock & Wilcox boiler is followed by a detailed description of the present types. Throughout, the modern boiler has been compared to the ideal boiler as outlined in the late Admiral Melville's list of essential characteristics. The book is very complete. It contains much accurate data that cannot be obtained elsewhere, and should have a place in every marine engineer's library on account of the extensive use of the Babcock & Wilcox boiler in marine practice.

STEAM BOILERS. Third edition. By C. H. Peabody and E. F. Miller. Size, 6 by 9¼ inches. Pages, 543. Illustrations, 229. Folding plates, 5. New York and London, 1912: John Wiley & Sons and Chapman & Hall, Ltd. Price, $4; 17s. net.

Authoritative books on steam boilers are not very plentiful. What few there are, either deal directly with the thermodynamics of the generation of steam or with the mechanical details of boiler construction. In this book, which was primarily intended for the use of students in technical schools and colleges, theory and practice each have an equal share in the explanation of the construction and operation of steam boilers. The subject is thoroughly covered by giving only clear and concise statements of facts concerning boilers. No preference has been given to any one particular type, each type being described in detail. Following a description of various types of boilers, a chapter is devoted to superheaters and this includes a short discussion of superheated steam. The chapter on combustion has been extended in this edition to cover oil burning and to include the most recent analyses of American coal, together with a detailed description of coal calorimetry as applied to the determination of the heating value of coal purchased on a heat unit basis. This chapter alone would make a very interesting book, as the matter has been presented in the careful and thorough manner which is characteristic of the authors. Corrosion and incrustation are discussed in great detail, and the subjects of mechanical stokers, economizers and steam piping have been treated at considerable length. The new edition also includes new material on chimney draft and a chapter on coal handling and coal-handling machinery. The subjects of riveted joints, boiler testing and staying flat surfaces have also been extended and are very complete. The design of the horizontal return tubular boiler is the only one taken up in detail as the principles in the design of different types of boilers are the same throughout.

THE NAVAL CONSTRUCTOR. Third edition. By George Simpson. Size, 4⅛ by 6⅜ inches. Pages, 819. Illustrations, 366. New York, 1914: D. Van Nostrand Company; London, 1914: Kegan Hall. Trench, Trübner & Company, Lt. Price, $5 net.

In practically every branch of the engineering profession there is available a standard handbook giving in condensed form for ready reference the principal data constantly required by the engineers, draftsmen and manufacturers specializing in that particular branch. Naval architecture is no exception in this respect, and, in this case, the need is admirably filled by Simpson's "Naval Constructor," the third edition of which has just come from the press.

From its first appearance, ten years ago, the "Naval Constructor" has been noteworthy in the manner in which "unified details" are presented. The new edition has been considerably enlarged by the addition of further "unified details" and new matter dealing with ventilation and other subjects, while the old matter has been thoroughly revised and brought up to date.

The book is divided into seven sections, dealing respectively with ship calculations, strength of materials, fittings and details, rigging and ropes, equipment, miscellaneous data and mathematical tables. The first section, which covers 277 pages, is in itself a valuable text-book, and treats the subject of ship calculations in a thoroughly practical manner. The chapter on freeboard, including freeboard tables, is of special value, as also are the tables of weights, the notes on specification writing and the chapters on strength of ships and resistance. In this connection, an interesting table gives some useful data covering vessels varying from 65 to 600 feet in length. While much of the information regarding the strength of materials can be found elsewhere, that which refers to the strength of columns, shackles and riveting is specially convenient for naval architects.

The third, fourth and fifth sections of the book, which cover over 400 pages, give a mass of useful data collected from a great variety of sources, and it is presented in a most convenient and useful manner. The thousand and one details given in these pages are constantly needed by designers and others who have to do only with the maintenance and operation of steam vessels. The author's careful compilation of this information will be widely appreciated.

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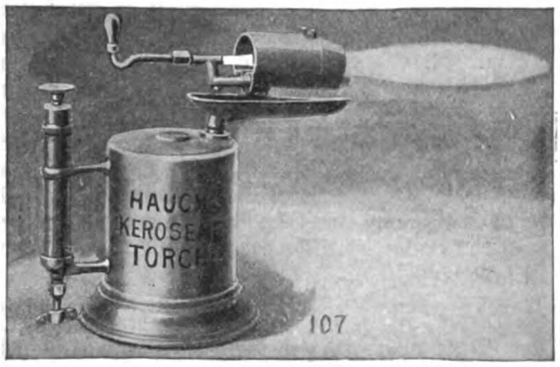
ENGINEERING SPECIALTIES

The Hauck Kerosene (Paraffin) Torch

A kerosene (paraffin) torch of new and novel design, especially made to take the place of the gasoline (petrol) torch, has just been placed on the market by the Hauck Manufacturing Company, of Brooklyn, N. Y. The most important feature is the construction of the bronze burner. The oil passageways are especially large and so arranged that only one plug has to be unscrewed in order to clean the whole burner instantly. By a special oil regulating



Hauck Kerosene (Paraffin) Torch

valve the flame can be adjusted to any size from 8 inches long by 1 inch in diameter to the finest point.

As kerosene (paraffin) contains more heating units than gasoline (petrol), the temperature obtained with this torch is much higher than that of the gasoline (petrol) torch, which makes it especially suitable for brazing pipes, wires and small machine parts, burning off paint, shrinking and expanding, as well as for general ship repair work. It is also claimed that strong wind or cold weather will not effect the flame in any way, and it is therefore especially recommended for use on board ships and for outside work.

The torch is also furnished in connection with a light furnace for melting solder and heating soldering coppers.

Vismera

The Inland Steel Company, Chicago, Ill., is manufacturing *Vismera* rust- and corrosion-resisting iron sheets which are particularly adaptable to the construction of ships' hulls or for the roofing of docks, warehouses, etc. In manufacturing *Vismera*, it is claimed the possibility of any foreign substance getting into the material is avoided and that 90 percent new pig iron is used from the ore, together with 10 percent of *Vismera* crop ends. This is refined to a certain point and the resulting pure iron content is said to be from 99.55 to 99.60. An alloy is then made in the ladle containing this pure iron content with .2 of pure copper and .2 of pure manganese, which is claimed to result in a total purity of alloyed metals of practically 99.932 percent.

From experiments, in which an ordinary block of steel and a block of *Vismera* were welded together and suspended in a 20 percent solution of sulphuric acid for thirty hours, it was found that the steel was badly eaten away and the *Vismera* was untouched by corrosive action. Superiority is further claimed by means of various tests side by side with various brands of iron, steel and "metal," such as tests in wet sand, air and water, air and salt brine, gases, fumes, snow and rain.

Vismera sheets are offered black and galvanized, in all standard sizes and gages.

New Watson-Stillman Hydraulic Jack

The Watson-Stillman Company, New York, has just brought out a new type of hydraulic jack that embodies features entirely new in hydraulic jack construction. Primarily the design was intended to cover the demands of an emergency jack for street railway use, but according to the manufacturers it has proved so sure and reliable at all times, so easy to handle and operate, that it will be welcomed by any shop or factory where lifting work is occasionally or constantly performed. By referring to the illustrations the following unusual features will be noted:

1. The claw can be moved vertically and adjusted to the most convenient height, and can with the cylinder be swung in a complete circle without changing the position of the jack or of the pump level.

2. The cylinder is the moving part of the jack instead of the ram, as in the ordinary type of jack, thus allowing the pump mechanism to stay in a fixed vertical position and permits the working parts of the jack to be made simpler and more compact than is usually the case.

3. The piston is packed with leather rings, the valves are of the ball type, and all passages are made amply large, resulting, it is claimed, in a practically fool-proof construction.

4. This jack is operated with a special oil which, it is claimed, as well as acting as a lubricant, prevents rust on

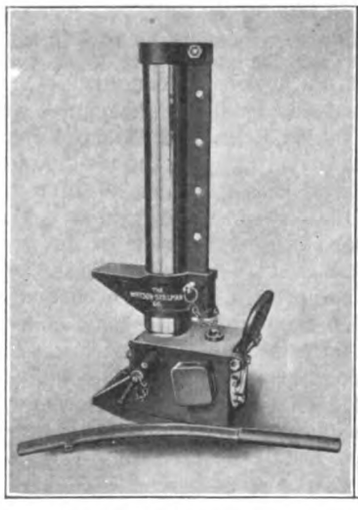


Fig. 1.—Hydraulic Jack

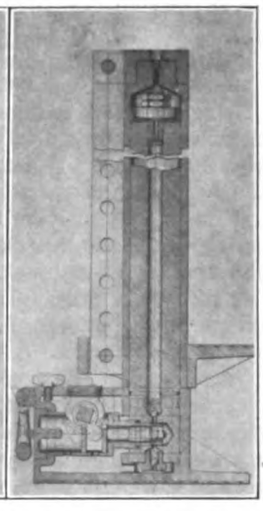


Fig. 2.—Section of Jack

working parts, the possibility of freezing, and has no detrimental effect on the packings.

5. The releasing of the pressure is by a key operating a small needle valve.

6. While the operating lever is but 18 inches long, one man weighing 125 pounds can obtain the maximum pressure with but slight effort. The lever is made curved in shape and the socket has a hole in each of its four sides to allow convenience in operation from practically any position.

These jacks are now built in 5- and 10-ton sizes, with a ram stroke of 10 inches, and are guaranteed to stand a 50 percent overload without detrimental effect to any of their parts.

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Personal

Samuel Hutton will finish the season as chief engineer of the steamer *Betty* at Waterford, N. Y., on the upper Hudson.

John Falkerer, formerly with the New London Towing Company, has accepted a position as chief engineer of the steamer *Joseph Garrett,* of New Haven, Conn.

Ten Eyck Hotaling, of Stuyvesant, N. Y., chief engineer of the *Sirius,* of the Iron Steamboat Company, New York, will make his home at Edgewater, N. J., during the winter.

Frank Gosselin, chief engineer of the twin screw steamer *Julia Safford,* has taken a position with the McHarg Construction Company, Albany, N. Y., for the winter months.

John W. Waters, formerly New York representative of the Kingsford Foundry & Machine Works, Oswego, N. Y., has been appointed local inspector of boilers at San Juan, Porto Rico.

Joseph Lindsley, formerly employed by the Bridgeport Towing Company, Bridgeport, Conn., has accepted a position as chief engineer of the tugboat *Joseph Penn,* of New Haven, Conn.

H. H. Hodell was elected president of the Van Dorn & Dutton Company, Cleveland, Ohio, at a special meeting of the board of directors, held October 12, to fill the vacancy caused by the death of James H. Van Dorn.

C. L. Morrison, who has for a number of years been marine superintendent of the Lackawanna Steel Company, has accepted the position of chief estimator for the Seattle Construction and Dry Dock Company, Seattle, Wash.

Naval Constructor D. W. Taylor, it is understood, will be appointed chief of the Bureau of Construction and Repair, Navy Department, Washington, D. C., on December 13, when the appointment of Chief Constructor R. M. Watt in that capacity expires.

E. H. Weaver, shipping manager of the Benedict, Manson Marine Company, of New Haven, Conn., which operates a large fleet in the coastwise trade, has been elected an honorary member of the Marine Society of New York. This society was organized in 1746.

Albion Saulsbury, who is eighty-one years old and a pioneer engineer on the Hudson River, suffered a paralytic stroke at Rensselaer, New York, October 25. For a good many years Mr. Saulsbury was chief engineer of the steamer *City of Hudson.*

Samuel Shoemaker, recently with the government fleet on the Ohio River, has accepted the position of assistant engineer on the towing steamer *John Summers,* which has a large contract for towing raw material from the South. Sid. P. Terry is chief engineer of the *John Summers.*

George B. Langin has charge of the engine room of the steamer *Clinton,* which has been engaged to do towing for the Newburgh Dredge Company, which is dredging the Albany basin at Albany, N. Y. The *Clinton* was previously in service on Long Island Sound. Captain Percy Wolfe is the commander.

Captain W. D. Burnham, manager of the American-Hawaiian Steamship Company, New York, retired from active service on November 2. Since Captain Burnham's retirement the office of manager has been discontinued, while the office of superintendent of the line has been created and will be filled by J. D. Tomlinson, formerly assistant to Captain Burnham.

T. W. Spencer will be chief engineer of the new turbine passenger steamship *Great Northern,* just built by the William Cramp & Sons Ship and Engine Building Company, Philadelphia, Pa., for the Spokane, Portland and Seattle Railway Company. The *Great Northern* is a triple-screw, 23-knot ship of 8,255 gross tons, fitted with Parsons turbines and oil-fired watertube boilers. She will run between Astoria, Ore., and San Francisco, Cal.

Charles W. Wall, assistant to the superintending engineer of the Erie Railroad Lake Line, was recently presented by his old associates in the Erie system with an exact half-size replica of the house flags flown by the ships of the Erie fleet. Mr. Wall is one of the best-known marine engineers on the Great Lakes and has been continuously in the service of the Erie Railroad Lake Line since 1867.

Obituary

William H. Olenburg, late treasurer and superintendent of the Ohio Machine & Boiler Company, died October 9 at Cleveland, Ohio.

William B. Bryan, chief engineer of the Metropolitan Water Board, London, died October 28. Mr. Bryan was to have delivered the "Thomas Hawksley" lecture before the Institution of Mechanical Engineers on October 30.

Clarence Williamson, until recently assistant treasurer of Joseph T. Ryerson & Son, Chicago, Ill., died suddenly November 11 at Vincennes, Ind., while on an automobile trip. Mr. Williamson was connected with Joseph T. Ryerson & Son for twenty-five years, and was forced to give up work two years ago on account of ill-health.

Alfred Booth, founder of the Booth line of steamships, died in London November 2. About fifty years ago Booth & Co. was founded by Alfred Booth in partnership with his brother, the Right Honorable Charles Booth, Privy Councillor. The firm is now known as the Booth Steamship Company, Ltd., and is in charge of one of Mr. Booth's sons.

Thomas Congdon, formerly principal surveyor of Lloyd's Register of Shipping in the United States, died recently at Glenridge, N. J., aged eighty-five years. Mr. Congdon entered the shipping industry in 1842 as a shipwright apprentice in the Royal Dockyard at Devonport. He had been connected with Lloyd's Register since January 1, 1856, and served on the staff at Greenock, Bristol and London until 1882, when he was appointed principal surveyor of Lloyd's Register of Shipping in America, where some years ago he was succeeded by Mr. James H. Mancor, who still occupies the position.

Tom R. Davis, mechanical expert of the Flannery Bolt Company, Pittsburgh, died in his sixty-first year at his home, Dravosburg, Pa., on October 12. When eighteen years of age, after a public school education, he began work as a machinist's apprentice with the Allegheny Locomotive Works. In 1875 he secured a fireman's position and the following year was promoted to that of engineer. The following year he entered the employ of the Crosby Gage & Valve Company as special agent. He left that company in 1880 to accept the position of manager of the Monongahela Manufacturing Company at Monongahela City, but later he returned to the employ of the Crosby company, with whom he continued until 1892, when he was employed by the Garlock Packing Company. In 1898 Mr. Davis was employed by the Homestead Manufacturing Valve Company as special expert, leaving that company in 1904 to enter the employ of the Flannery Bolt Company as mechanical expert, which position he held at the time of his death.

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SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Millerton, N. Y.

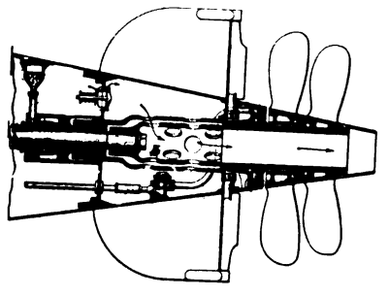
1,112,106. SOUNDER. EDWARD C. WOOD, OF SOMERVILLE, MASS., ASSIGNOR TO SUBMARINE SIGNAL COMPANY, OF WATERVILLE, ME., A CORPORATION OF MAINE.

Claim 1.—The sounder above described comprising a bell, a cap having substantially the same diameter as the bell, a gasket, said cap being

clamped to said bell to form an inclosure and said gasket being located between the edges of said cap and said bell whereby it will allow the vibration of the bell and will prevent the leakage of water into the said inclosure. Four claims.

1,108,196. AUTOMOBILE TORPEDO. FRANK M. LEAVITT, OF SMITHTOWN, N. Y., ASSIGNOR TO E. W. BLISS COMPANY, OF BROOKLYN, N. Y., A CORPORATION OF WEST VIRGINIA.

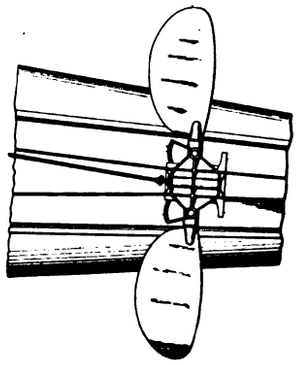
Claim 3.—In an automobile torpedo comprising a compressed air motor, oppositely revolving propeller shafts one within the other, a chamber receiving the exhaust from said motor, an oil-cup having a discharge



duct leading to a bearing, said cup open to the air pressure in said chamber above the oil level for subjecting the oil to pressure to expel it, and a check valve in said oil duct adapted to prevent any back flow of water through said duct into said chamber. Three claims.

1,108,192. SUBMERSIBLE BOAT. GUSTAV M. LAGERGREN, OF NEW LONDON, CONN., ASSIGNOR TO ELECTRIC BOAT COMPANY, A CORPORATION OF NEW JERSEY.

Claim 1.—A submersible vessel having a body, hydroplanes mounted thereon and movable to inoperative positions against the body and to extended positions and a single operating mechanism connected to the



hydroplanes and operable to move them from the inoperative to the extended position and to move them to any desired angular position while in the extended position; substantially as described. Twenty-two claims.

1,112,014. RETARDING DEVICE FOR AUTOMOBILE TORPEDOES. FRANK M. LEAVITT, OF SMITHTOWN, N. Y., ASSIGNOR TO E. W. BLISS COMPANY, OF BROOKLYN, N. Y., A CORPORATION OF WEST VIRGINIA.

Claim 2.—A retarding device comprising a traction bar, two rollers on opposite sides of said bar, gearing for driving one roller for displacing the bar, the bar having a recess in which the other roller may fall, a part the movement of which is to be retarded connected to said latter roller, and an adjustable stop for varying the starting point of said traction bar to adjust the duration of retardation. Three claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn Place, W. C., London.

11,540/1913. DETECTING ICEBERGS AT SEA. PROF. DR. F. KRÜGER, OF 141 HAUPT STRASSE, LANGFUHR, NR. DANZIG, GERMANY.

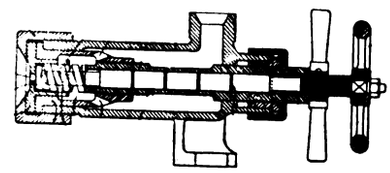
Improved means for detecting icebergs at sea, comprises in combination, a comparatively large spherical or parabolic concave mirror adapted to receive the heat radiated from the iceberg, a surface thermopile, or bolometer, located at a point coinciding with the focal point of the concave mirror and upon which the heat rays are directed, and a movable coil galvanometer, or electro-magnetic Wollaston wire, or like galvanometer connected to the surface thermopile or bolometer.

9292/1913. VENTILATORS FOR SHIPS AND THE LIKE. MECHAN & SONS, LTD., S. MECHON, AND A. J. LEWIS, ALL OF SCOTSTOUN IRON WORKS, GLASGOW.

Claim.—Comprises the construction of a ventilator having a vertical air shaft covered over by a dome, and fittings arranged to form a downwardly extending passage around the exterior of the air shaft, having an inverted valve seating of annular form at its base, arranged so that air may pass through the air shaft to beneath the dome and from thence through the passage past the valve seating to the atmosphere or in the reverse direction, in conjunction with an annular valve adapted to rise under the action of water against the inverted valve seating and close communication between the atmosphere and the air shaft.

13,355/1913. IMPROVEMENTS IN BURNERS FOR LIQUID FUEL. H. E. YARROW, OF YARROW & CO., LTD., OF SCOTSTOUN, GLASGOW.

Claim.—In the construction shown the whirl velocity of the oil or other liquid fuel is varied by varying the width and pitch of the spiral



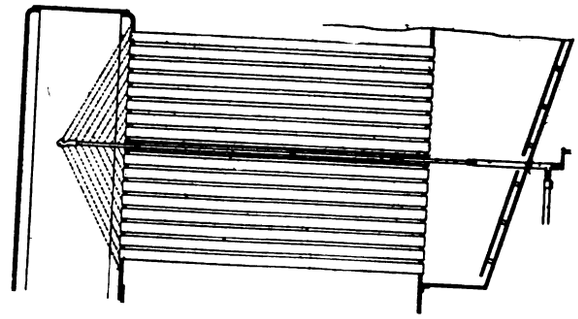
duct through which the oil (preferably heated) is forced under pressure, the duct being formed by the spires of a helical spring which encircles the end of the regulating spindle whereby the rate of fuel consumption is controlled.

11,561/1913. IMPROVEMENTS IN OR RELATING TO MARINERS' COMPASSES OF THE PROJECTOR TYPE. KELVIN & JAMES WHITE, LTD., OF CAMBRIDGE STREET, Glasgow, and M. B. FIELD.

Claim.—A liquid compass of the projector type, the bowl of which is gimballed on an axis located above the plane of the card, the axis of gimballing being spaced from said plane a distance dependent *inter alia* on the index of refraction of the liquid in the bowl, and such as to compensate for error in reading due to rolling of the ship.

14,254/1913. APPARATUS FOR CLEANING SMOKE TUBES OF MARINE AND OTHER MULTI-TUBULAR BOILERS. G. C. DYMOND OF 6 LORD STREET, LIVERPOOL. (COMMUNICATED BY C. H. SHEPLER AND J. W. SHEARER.)

Claim.—The invention consists of a hollow shaft or pipe passed through one of the smoke tubes, and capable of being rotated and, at the same time, slowly advanced longitudinally, is provided at one end beyond the smoke tubes with a blower head projecting radially from the hollow shaft



and adapted when the pipe is rotated to blow obliquely a jet of steam or other pressure fluid first into the tubes nearest to the one through which the hollow shaft is passed, and then by advancing the hollow shaft longitudinally so that the range of the nozzle is increased, and continuing to rotate it, the said nozzle will blow a jet of pressure fluid into all the other smoke tubes in turn, whereby the said smoke tubes or a series of them can be successively cleaned, without changing the centre of rotation, or dismounting any of the parts.

27,287/1913. A DEVICE FOR INCREASING THE EFFICIENCY OF A SCREW PROPELLER. H. HASS, OF 29 ISESTRASSE, HAMBURG, GERMANY.

The combination of a screw propeller with a plurality of fluid directing blades arranged adjacent to and in the path of the water stream flowing on to said propeller and arranged inclined oppositely to the blades of said screw propeller to impart to the current of water a high positive angular velocity in a direction opposite to the direction of rotation of the propeller of such an extent that the said positive velocity is approximately equal to the negative velocity of rotation imparted to the fluid by the screw propeller, so that the slip stream leaving the propeller has substantially zero angular velocity.

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